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Can't Get Double Pay.

WHEN Mr. Thomas Commerford Martin was discharged from the position of editor of THE ELECTRICAL WORLD for what Mr. Johnston considered, and still considers, gross dereliction of duty, he immediately sought and obtained employment with another electrical publication. He, however, refused to sell back to Mr. Johnston certain shares of the stock of the W. J. Johnston Company, Limited, which had been given him under a written agreement that when he left the company's employ they should be so sold back to Mr. Johnston. Several months after the discharge Mr. Johnston wrote a letter to Mr. Martin with a view to having him carry out this part of the agreement, and on the strength of that letter Mr. Martin brought suit for the stock that would have come to him if he had faithfully carried out his agreement until the end of that year. Thus, while working for one journal, in direct violation of his agreement with another, he asked that this other journal should also pay him for the same time! The suit has, of course, been decided against Mr. Martin. The opinion of the referee will be found in full in this issue.

The Design of a Central Station.

THE question of the design of a central station for incandescent electric lighting, which is di cussed elsewhere in these columns, is one which is coming to receive more careful attention on the part of engineers as well as those who are interested in the electric lighting business from a financial standpoint alone. Prof. Roberts, its author, attacks the question in a most original and instructive way, and we believe that his methods will cover the subject more fully than could be done in any other manner, for the reason that he assumes the conditions as they are likely to be found in almost any locality with all the complexities which are likely to arise. These he discusses from the standpoint of the business man, and shows how the difficulties can best be surmounted, giving the reasons therefor so clearly as to be well understood and to enable one to see how the conclusions might be radically different were the conditions but slightly modified. While discussing the central station from the business man's standpoint he also shows how the engineer arrives at his conclusions by his own course of reasoning.

Rapid Transit in New York.

AFTER several years of backing and filling a definite scheme of rapid transit, so-called, has at last been adopted by the Rapid Transit Commissioners, but from any other point of view than that of expediency the result is far from satisfactory. The plan adopted merely gives up more streets to the Manhattan Railway Company, and although an express system is provided for the remedy is only a partial one that will delay real rapid transit by means of electricity for some years. The feeling cannot be averted that if the Commissioners had been heartily in favor of rapid transit separate from the Manhattan Railway Company one of the several schemes involving the employment of electricity would have succeeded. As it is, the city will be further defaced by unsightly structures, and the din and smoke of the elevated trains inflicted on thousands of more victims along the new routes. Whether an attempt will be made to obviate part of the nuisance by the substitution of electricity as the motive power remains to be seen, but as the Commissioners did not refer to this in the franchise offered there seems to be no immediate prospect in this direction. It will be interesting to note what construction the Manhattan financiers, if they accept the Commission's proposal, will place upon the term "net receipts" when their payments to the city become due.

Columbia Incandescent Lamp Case.

AS MOST of our readers will remember, this was a hearing on motion for a preliminary injunction by the Edison Electric Light Company against the Columbia Incandescent Lamp Company, of St. Louis. On Jan. 17, 1893, a restraining order was issued by the court at the instance of the plaintiff; and this being granted *pro forma*, the hearing was set, after several postponements, for Tuesday, April 11. With some of the details of the defense our readers have already been made familiar through reports in THE ELECTRICAL WORLD of a somewhat similar case against the Beacon Vacuum Pump and Electrical Company, of Boston, in which what has become known as the "Goebel defense" was set up. As will be remembered, Judge Colt found for the plaintiff in the Beacon case, and the injunction was granted. This latter case attracted a great deal of attention at the time, but the decision of Judge Colt was considered by many to have virtually settled the Goebel defense as untenable. It was assumed that the defense in the Columbia case would be the same and that the trial would be but a repetition, perhaps on a larger scale, of that in Boston. For this reason, probably, the Columbia case has attracted but little attention; and THE ELECTRICAL WORLD alone, of all of the electrical papers, was represented at the trial. But, as the sequel proved, the assumption that this was to be but a repetition of the Beacon case was entirely erroneous, and the proceedings in this instance surpassed by far in interest those which characterized the former case. In this it was admitted by the defendants that if the injunction were granted the result was annihilation, while the plaintiffs admitted that if the injunction were not allowed it practically destroyed the value of the Edison lamp patent, and each side presented its case in the strongest possible aspect, and no stone was left unturned, by the turning of which a single point, however immaterial, might be gained. Perhaps no recent case has been more ably argued on both sides than was this one, and perhaps in none have the results been more far reaching than will those be in this. One of the remarkable features of the Columbia Incandescent Lamp case was the summing up for the defendant by Mr. William H. Kenyon, which was pronounced by many of those present as one of the ablest arguments they had ever heard.

Columbia Incandescent Lamp Case: Defense.

THE defendant in the Columbia incandescent lamp case claims that their defense is entirely new; that the points involved have never been previously adjudicated, and that for this reason the decision of Judge Colt has no bearing whatever. It is claimed that the invention for which patent was issued to Edison consisted in the substitution of a carbon filament, and that this was limited, or should have been limited, to a coil carbon filament. That the patent is limited in its narrow sense to platinum leading-in wires only by the construction of the plaintiffs, and not by the wording of the patent which uses the broad term "conductor;" that, therefore, the use of iron or copper leading-in wires would be as much of an infringement as the use of platinum leading-in wires, and that therefore the prior use of iron leading-in wires would have been as much an anticipation as would have been the prior use of platinum. The defendant also claims that the present Edison lamp which they are charged with having infringed is not the product of the Edison patent of 1879, but of a much later patent of Edison which they are not charged with having infringed. The defendant also claims that none of the lamps made according to the Edison patent of Oct. 12, 1879, were operative or practicable and that the features which have been introduced in the present Edison lamp, which have rendered it a practicable lamp were introduced by Edison at a much later date. The defendant further claims that Judge Wallace's decision was asked on the assumption that the carbon filament was new to the art at that time and that being new its substitution for a platinum filament constituted invention whereas if it had been known to the art its substitution would not have been invention. It is claimed that the carbon filament was not new to the art and that therefore the Edison patent upon which this action is based is invalid and the defendant does not infringe. The defense is "non-infringment."

Columbia Incandescent Lamp Case: Prosecution.

THE plaintiffs put in essentially the same claim as they did in the Beacon case. They deny there is anything new in the present defense except additional testimony on already adjudicated points; they deny that the Edison patent of 1879 is confined to the narrow limits stated by the defendant, and claim that the coiled filament was merely a preferred method stated by Edison as required by law. They maintain that the question of the carbon filament as new to the art has been settled once for all by Judge Wallace's decision, and cannot be overthrown without evidence of the most postive kind. They deny the genuineness of the exhibits of the defence, aver the insufficiency of the evidence, and claim that the patent can only be overthrown in a court of the same jurisdiction as that in which it was affirmed where the points at issue are the same as they claim they are in this case.

Theory vs. Practice.

"THAT is the theory, but it don't work in practice," is a saying that would not be so frequent were it more generally kept in mind that true theory is but the expression of observed facts—in other words, of practice itself. The popular disrepute in which theory is held is largely due to popular ignorance, but also in part to the misuse of the word by those who should know better. When many popular scientific writers habitually confound theory, hypothesis and speculation we cannot blame severely the novice who builds up a speculation based on few or no facts, and thinks he has founded a legitimate theory. Speculation and hypothesis are valuable tools for the scientific worker, but they should not be confounded with the finished product, theory, the statement and co-relation of accepted facts and their logical deductions. More frequently, however, theory has to suffer discredit from being only partly understood or judged by an isolated statement made to do duty for the whole. For example, a current saying is that the theoretical line of commutation of a dynamo passes through the middle of the openings between the pole pieces, but in practice the brushes have to be moved ahead. What theory does say, of course, is that in a certain specific case never met with in practice this is true, but that in the case of a dynamo giving current the position of the line of commutation depends upon a number of factors whose resultant action places the practical line of commutation at an angle that varies more or less with every change in these factors. Of a still lower order is the confounding of a mere *dictum* with theory, as in the statement, sometimes heard, that a 6.8 ampère arc lamp gives a theoretical candle power of 1,200. In general, it may be assumed that those who dogmatically denounce well estalished theory are either incapable of interpreting it or adopt that course to cover their ignorance of the subject in question. On the other hand, no one should be deterred from examining into the truth of a theory by the weight of the authority in its favor. The discovery of new facts may show that those already known can be interpreted in an entirely different light.

Mr. A. S. Terry on the Lamp Question.

To the Editor of The Electrical World:

I have read with much interest the series of articles you have been publishing on the incandescent lamp situation, giving the views of the different electrical interests. While I do not think that the incandescent lamp manufacturers are warranted in entering into general discussion of this question at the present time, I do think that your account of the interview with Mr. Fish, of the General Electric Company, affords sufficient warrant for an explanation of the present state of the litigation from the outside lamp manufacturers' point of view. Mr. Fish, if correctly reported in your issue of April 1, says:

"That he and the officers of the General Electric Company had supposed that when the validity of the Edison patents had been established in the Sawyer-Man case it would end the matter so far as the rights to the lamp were concerned, and no further trouble on that score would be encountered. To their surprise, however, the outside lamp manufacturers had gone complacently on without so much as saying 'By your leave,' and had defied the company, which found that the only course open to it was to enforce its rights."

This is in line with that sentiment which terms the outside manufacturers "Pirates," and implies that they have deliberately entered into the business of manufacturing lamps with the intention of defrauding the Edison interests of what was rightfully their due. I do not remember having seen anywhere a protest from any of the lamp manufacturers to this statement of the case, and believe that there are some facts that can be stated that will place this matter in an entirely different light.

In the first place nearly all the parties now engaged in manufacturing lamps were in the business previous to July 14, 1891, when the first decision in favor of the Edison interests was rendered, and most of them had gone into the business without the slightest intention of infringing the rights of any patentee. The business had been practically open to any party having the necessary ability and capital, and the trade at large had come to consider the manufacture of incandescent lamps a legitimate business. The decision of July 14, 1891, opened their eyes to the fact that an incandescent lamp of certain construction was covered by the Edison patents, and that they were liable to be placed in the position of parties manufacturing an infringing article.

Had the Edison interests at that time taken any steps looking to the enforcement of their rights with outside companies, and had they proposed any fair and equitable arrangement whereby those engaged in the business could continue upon payment of a royalty, I believe that every one of the outside manufacturers would have been willing to have made such an arrangement.

When the decision was confirmed in August, 1892, I am informed by creditable authority that nearly every outside lamp manufacturer in the country offered to acknowledge the validity of the Edison patents and to continue the manufacture on a royalty basis, leaving the question of amount of royalty to those who control the Edison patents, but in no case were any of the manufacturers able to make any arrangement, or to get from those who controlled the Edison interests any encouragement that they would be allowed to continue in the manufacture of lamps on any basis whatsoever.

It then became a question of continuing in the business under the same conditions as before, or abandoning capital and experience invested in the business. As the case had been appealed to a higher court and there was a possible chance that the decision might be reversed the manufacturers continued in the business; all the time, however, expressing to those controlling the Edison patents a disposition to make any reasonable settlement for back royalty, provided they might be allowed to continue on under a license.

This was done in many instances, not because the manufacturers were willing to admit theirs was a lamp which infringed, but simply as a good business policy, believing it better to pay such an amount as would be considered fair and right for royalty rather than to spend an equal amount in litigation, which might terminate unfavorably.

Had the outside manufacturers put upon the market inferior lamps, or had they sold lamps at lower prices than the Edison lamps were sold at, there would be more ground for complaint from those who control the Edison patents than there is, but it is an undisputed fact that the more successful outside manufacturers were able to secure their business at higher prices than those for which the Edison lamps were sold, because the lamps furnished were of better quality.

If the General Electric Company has no other purpose in view than to secure such remuneration as they are fairly entitled to under a just interpretation of the incandescent lamp patent, they would certainly have no difficulty in making arrangements that would be satisfactory to all the electrical industries. If they do not intend to use the lamp as a means to control the entire electric lighting industry, why do they refuse to offer any terms of settlement to the outside concerns?

So far their policy has left no other course for the outside lamp manufacturers than (to use the words of one of the high officials of the General Electric Company). "Lie down, sell out or fight," and, as under the circumstances it is impossible to sell out, the whole question narrows to the two alternatives, either lie down or fight. Under the circumstances no one can blame them if they do not lie down; and if they are forced to fight, it is simply the fight that any man is entitled to make for self preservation.

If the present position of the outside lamp manufacturers is "a surprise to Mr. Fish and the officers of the General Electric Company," they are largely responsible for it, as the harsh policy which has been adopted by those controlling the Edison interests has left no other course open to the outside manufacturers.

From present indications this harsh and uncompromising policy on the part of the General Electric Company is likely to prove a blessing in disguise, as some of the outside interests have, under the pressure of threatened annihilation, accomplished results which bid fair to place them in a position of complete independence and have enabled them to accomplish results which it is not likely they would have done under other circumstances.

While no one should sympathize with a policy which would prevent an inventor from securing the remuneration he is justly entitled to, the patent laws should not be so interpreted as to enable a combination to use one patent to control a variety of different interests and to place an important industry beyond the reach of inventive skill for a long period of years. While Edison may have been the first one to produce a commercial incandescent lamp, the present advanced condition of electric lighting is largely due to the inventive skill and patient labor of others. While Mr. Edison and those controlling the Edison interests are fairly entitled to a just compensation for all incandescent lamps used which may be decided by legal authority to be an infringement on the Edison patents, the present attempt of the General Electric Company to use these patents as a means to control the entire electric lighting industry should be opposed as a matter of public policy. The refusal of the General Electric Company to treat with outside lamp manufacturers and the statements of those high in authority that they propose to control the entire business, and that those purchasing electric lighting apparatus from other makers would not be able to procure lamps, warrants the general public in believing that this is their policy and that they will leave no means untried to accomplish their purpose.

ALBERT S. TERRY.

CHICAGO, April 8, 1893.

Single-Phase Alternating Current Motors.

BY C. E. L. BROWN.

Since the appearance of my article on single-phase alternate current motors, some little correspondence on the subject has arisen to which I now beg to submit the following answer:

I should have written before this, but I have been for some time absent from Baden and I also wished to give time for the other side of the question to be carefully stated before replying.

On reading the various letters I was really amused to notice how that, after the publication of the particulars of my motor, every one has suddenly discovered that he invented it himself long ago. I can only remark, and I imagine that most readers of the correspondence will agree with me, that had any of these motors come within measurable distance of a solution of the problem they would, long ere this, have come into general use. Prof. Elihu Thomson claims to have produced such a motor in November, 1888, and MM. Hutin and Leblanc had, as early as May, 1891, so complete an insight into the underlying principles of the problem as to write an elaborate mathematical article upon the subject. In neither of these cases, nor in that of Mr. Tesla, who also worked in the same direction, was there any lack of capital to assist in bringing the motors before the public; yet, although in each case ample time has elapsed, the machines have come into use in spite of the fact that there has always been a great demand for a self-starting alternate current motor without a commutator.

I have no wish to underestimate the importance of the work done by Prof. Thomson, Mr. Tesla, and other early workers in the field, but I would point out that certain points in their machines were inherently defective, and that it was only by remedying these that I have succeeded in producing a practical single-phase motor.

As some further elucidation seems to be necessary, I will describe more exactly the points in which my motor differs from the earlier ones and to which I attribute its success.

From the published figures and descriptions of the motors of Thomson, Tesla and Leblanc, it is apparent that the arrangement and winding of the magnetic circuit, both in the fixed and rotating parts, is suitable only for synchronous working, the number of poles and windings being the same in both. It will also be noted that all the above-mentioned motors have very sharply projecting poles, so that the magnetic resistance varies according to the position of the rotating part with regard to the fixed. The result of this will be, that the former will have certain positions in which it will tend to place itself, and only when in these positions can currents be properly induced in it.

Such a motor can only give power when running synchronously and cannot be started with a two-phase current, even if of exactly 90 degrees phase difference, as produced from a two-phase machine, except, perhaps, with very low periodicities, and even then without appreciable torque. In fact, in most cases the motor will only run if first brought up to almost synchronous running by some external means.

In the motor described in my article, on the other hand, there is no correspondence whatever between the winding or form of the magnetic circuit in the outer inducing and inner induced parts. On the contrary, they are, and must be, completely different from one another. It will also be observed that there are no sharply projecting poles, but that the inducing winding is carried in a large number of holes which are uniformly distributed over the whole surface of the iron. The short-circuited induced winding is also carried in holes uniformly distributed over the surface of the rotating part. The numbers of poles in the induced and inducing parts, respectively, must have no common factor. The result of this arrangement is, that when a single-phase current is sent through the outer or inducing winding, the inner part has no tendency to place itself in any particular position. If in such a system a second current is employed, as more exactly described by me in my article, having a difference of phase from the first, a turning moment in produced, the motor is started, and on reaching a certain speed this second current is cut out. The motor then runs up to a speed corresponding to its load, and only when running light will the speed approach synchronism. When loaded the speed of the rotating part sinks so far below synchronism that the current produced by this difference of speed gives the necessary torque. The extent of this drop depends on the form of the rotating part as explained in my former article. With regard to speed and armature current the motor is therefore exactly analogous to a direct current, shunt-wound motor. The bedding of the winding-in holes, as so often explained, is for the purpose of reducing the current required for the excitation net, thus securing a high plant efficiency. I would also point out that the weight efficiency of these motors is entirely dependent upon the proper choice of the various proportions. By suitable design remarkably favorable results may be obtained. Thus, I have now several 15 h. p. motors at work, giving this power at the low speed of 800 revolutions with a weight of only 500 kilogrammes, and the heating is practically nil.

As a matter of fact, one of these has been at work (in a sawmill at Ragaz) day after day, giving over 15 h. p. with moderate heating and has even been braked to 20 h. p. without pulling it up. Preliminary experiments show that the motor has a commercial efficiency of 88 per cent. to 90 per cent., the apparent watts being only about 12 per cent. in excess of the real watts. I must not omit to mention that this motor has no sliding contacts, and has sufficient starting torque to set in motion a line of shafting.

With regard to the letter from Mr. Arnold which appeared in several technical journals, I can simply state that the development of my motor dates from 1891, as stated in my article, and that after definitely settling all details I also applied for patents. Unfortunately I was sufficiently incautious to explain my improvements to various interested people, so that the secret more or less leaked out. In his letter Mr. Arnold attempts to treat the motor as a mere copy of those of Thomson and Tesla—whether from ignorance or design I am unable to say.

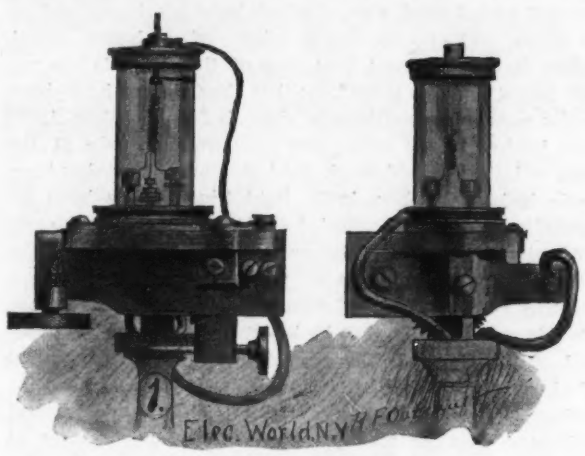
With regard to the letter of Messrs. Hutin and Leblanc, claiming priority in the invention of the motor in its essential principles, I would only say that from an examination of the French patent specification No. 204,456 it may be seen to be a two-phase motor of the Tesla type, the two phases being produced either from a special generator or by splitting the original current by means of a condenser which is always kept in circuit. Judging from my own experience I must rather doubt if this motor would start even with a two-phase current of 90 degrees phase difference, as the whole design points to synchronous working.

Referring to the American patent No. 407,844, mentioned by Prof. Elihu Thomson, I find no trace of the principle which he so prettily illustrates at the end of his letter, but which is, on the other hand, the principle of my motor. He shows a motor having sharply projecting poles and corresponding windings both on the fixed and rotating parts, and he specially mentions in his specification that the number of poles in both parts must be the same, thus producing, as mentioned above, a synchronous non-starting motor. If, as Prof. Thomson says, he could have made these motors work successfully at low periodicities, and was only prevented from introducing them into general use by the high frequencies in vogue in America, I would only point out that there was nothing to prevent the adoption of a lower frequency in the then early stage of development of the alternate current system, especially when we remember that now, after an immense number of high frequency plants have been installed, American practice is beginning to come down to lower frequencies. It seems incredible that Prof. Thomson could have been shortsighted enough not to have seen the enormous importance of the practical development of such a motor.

The Story of the Evolution of the Edison Incandescent Lamp.—I.

THE document presented in evidence in the incandescent lamp suit at St. Louis, last week, in the form of the affidavit of Mr. William J. Hammer, tells in a simple way the story of the evolution of the Edison incandescent lamp. No one, perhaps, in the world is more competent to tell this story than Mr. Hammer, who not only has made a part of that story himself, but has preserved specimens of the lamps which from time to time have marked important steps in that evolution.

We believe Mr. Hammer's collection is entirely unique in its completeness, and that the story as he so well knows it is now for the first time given to the public.



HAMMER'S EXHIBIT NO. 1

Valuable as this is as a contribution to a history now fraught with such interest to the public, it would be incomplete without fac-similes of the lamps referred to. Mr. Hammer has supplied these in a series of large photographs which we have been at pains to have redrawn, and the illustrations herewith shown are beautiful specimens of artistic work which will add greatly to the historical value of the article in question.

It will be borne in mind that the story as told is a legal document, drawn up especially for a most important suit at law, involving the validity of the Edison incandescent lamp patent in which millions of dollars have been invested either directly or indirectly. It therefore has been prepared with all the care that the importance of the case warranted, and is reliable, certainly, as an honest statement of the case as Mr. Hammer sees it. It has been robbed, however, of that charm as a story which Mr. Hammer's facile pen would

HAMMER'S EXHIBIT NO. 2.

have given it had he prepared it as a literary contribution rather than as a legal document, but it will lose nothing of interest by this, and we give it below in his own words:

"I became an assistant of Mr. Thomas A. Edison in his laboratory at Menlo Park, in the year 1879. Part of my earliest work was working with the vacuum apparatus employed in exhausting the Edison incandescent lamps. Shortly thereafter I took charge of various tests and experiments upon the lamps, plotting curve sheets, showing the life and economy of the lights, and making various notes and records of the general characteristics and special phenomena resulting from the various tests upon the lamps.

"From time to time I would secure certain lamps which showed interesting results in the experiments, or marked improvements in the manufacturing processes, thus forming the nucleus of a collection of incandescent lamps which I have continually added to, both here and abroad, during the past 14 years, until it makes a most interesting record of the art of electric lighting by incandescence. With a view of exemplifying the fact that all important inventions are gradual in their growth and development, I have made a selection of some steps in Mr. Edison's work which show the gradual progress of the experiments toward the standard Edison incandescent lamp as it is known to-day.

"Referring to the photographs which I have marked "Hammer's Exhibits 1, 2, 3," etc.—

"Exhibit 1 shows two of Mr. Edison's early platinum iridium thermostatic regulator lamps. The one marked "No. 1" is a perfect lamp, and was made in or about October of the year 1878. These lamps illustrate Mr. Edison's early work in incandescent lighting, employing platinum iridium wire in a receptacle which did not contain a vacuum.

"Hammer's exhibit 2 shows two experiments, one of which consists of a spiral of platinum iridium wire without the regulating device, and the other lamp having a number of strips of platinum foil joined in parallel or multiple arc. These lamps were made in or about November, 1878.

"Hammer's exhibit No. 3 shows one of the old thermostatic regulators for the platinum iridium lamp which is shown to the left, and on the right is a holder carrying one of the oxide of zircon lamps. In this lamp a fine platinum iridium wire was coiled upon a piece of pipe clay and the turns of the wire painted with oxide of zircon. These lamps were made on or about April, 1879.

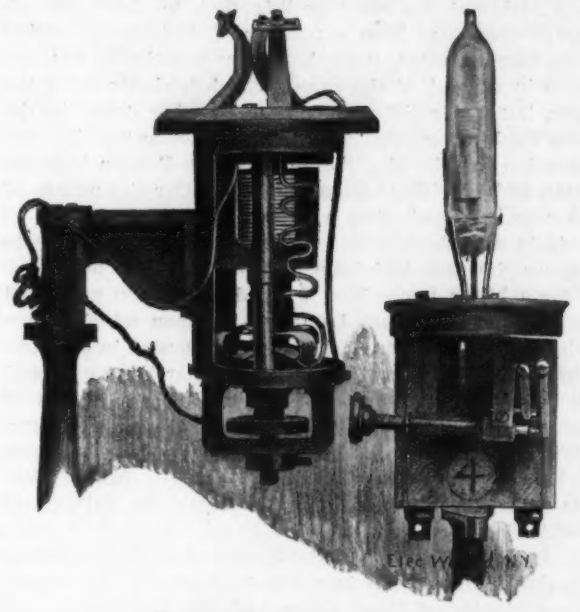
"Hammer's exhibit No. 4 shows the early type of platinum spiral, which marked the next important step, as the air was exhausted from the chamber containing the incandescent conductor. This identical lamp was made in the summer of 1881, to be sent to the Paris Electrical Exhibition, and is similar in general characteristics to the lamps made early in 1879.

"Hammer's exhibit No. 5 shows a marked step in Mr. Edison's work in which the carbonized paper horseshoe was used as the incandescent filament. Note the shape of the globe; the pointed tip at the top of the globe; the glass tips around the leading-in wires; the manner in which the platinum wire is twisted around the copper conductor at the upper end of the inside part; the supplemental tip of white German glass; the shape of the clamps which hold the carbon. Note, where the wires pass out of the bottom of the lamp, they are soldered on to two copper strips which are bent back over the edge of the glass and tied with thread with a view of facilitating the connection of the contacts in the lamp holder. In the irregular seal where the globe is joined on to the inside part, note that the glass has been burned. This lamp was made late in the year 1879 (November or December)."

The Columbia Incandescent Lamp Company Case.

The final hearing on the motion for preliminary injunction for the Edison Electric Light Company et al. vs. the Columbia Incandescent Lamp Company was commenced in the United States Circuit Court for the Eastern District of Missouri, before Judge Hallett, on Tuesday, April 11. It will be remembered that on Jan. 17, 1893, the Edison Electric Light Company obtained a preliminary restraining order against the Columbia Incandescent Lamp Company from the manufacture of incandescent lamps in alleged infringement of the Edison patents. In view of the previous decisions upholding the validity of the Edison incandescent lamp patent the judge granted the petition of the plaintiffs upon an ex parte statement by them, and a final hearing was set down originally, we believe, for Feb. 26, but was from time to time postponed until April 11, when the order was taken up before Judge Hallett as just stated. A display of legal talent was present, the plaintiff being represented by Messrs. F. P. Fish, of Boston; P. Dyer and C. C. Witter, of New York, and Henry Hitchcock, of St. Louis. The defendant was represented by Witter & Kenyon, of New York, and E. B. Adams and C. C. Fowler, of St. Louis. As those who are familiar with the recent Beacon case in Boston will see, with the exception of the local attorneys, the counsel is the same on both sides as were arrayed against each other at Boston.

Since the injunction which was sought against the Columbia Incandescent Lamp Company was asked for the same reason as that against the Beacon Vacuum Pump and Electric Company, of Boston, it has been assumed, and not without reason, that the defense in this case would be essentially the same as in the former, differing only, perhaps, in the vigor with which it would be made, and in the number of affidavits; it has in fact been repeatedly announced in the papers that the defense would be along the same lines as were pursued in the Boston case, and from the fact that Judge Colt decided in favor of the plaintiffs in the latter case it has been assumed by many that the decision in the present case would naturally follow for the plaintiffs, and interest has therefore somewhat flagged in the present proceedings. As a matter of fact, however, the Columbia Incandescent Lamp Company make in the present case what is claimed to be an entirely new defense. As stated by Mr. W. H. Kenyon, counsel for the defense, the question now before the court is purely one of infringement, and is a question never before decided or passed upon by any court, and that this is in every respect a new case as stated by the defendants. The previous decisions have been upon a question of the construction of the second claim of the Edison patent purely, and the question now before the court is, has the defendant proved that there was known in the art prior to Oct. 12, 1879, a filamentary carbon used for illuminating purposes as defined by Judge Wallace in his now celebrated decision. It is claimed that Judge Colt's decision does not affect this case, as the questions which came before Judge Wallace were not brought before Judge Colt, and that if this carbon filament was a part of the art as existing prior to the issue of Edison's patents then those patents cannot cover inventions or be used to blot out of existence a concern using the Goebel carbon; this the plaintiffs claim was directly an infringement, according to the ruling of Judge Wallace, who based his interpretation of the Edison patent upon the evidence which was presented to him at that time of what constituted



HAMMER'S EXHIBIT NO. 3.

the art. If the evidence upon which Judge Wallace decided was not complete and it could be shown at a subsequent date that the art had advanced materially beyond its state as then presented to Judge Wallace that fact would have a most material bearing upon the effect of his ruling.

The case was opened for the plaintiff by Mr. P. Dyer, of New York, who held that the process used by the Columbia company was identical with that covered by the Edison patents. A number of models of incandescent lamps were exhibited, and some of the earlier ones were of very peculiar shape, differing materially from those of the present day. Mr. Dyer occupied most of the morning and a portion of the afternoon, stating the case of the plaintiffs clearly and in detail, and arguing by means of the difficulties encountered in the evolution of the present Edison lamp of the improbability of the genuineness of the Goebel exhibits as presented before Judge Colt in the Beacon case.

As a presentation of the

HAMMER'S EXHIBIT NOS. 4 AND 5.

plaintiff's side of the case Mr. Dyer's statement was comprehensive and masterly; he argued that none of the lamps heretofore shown were operative, that the reproductions which had been shown to be operative were made with the advantage of new glass, the platinum leading-in wires, new carbonizing processes, and in fact with the advantage of all the knowledge of the present state of the art, and that even then they would only last but a very short time. He claims that Goebel cannot even now make a practically operative lamp, that he had tried and failed, and then went on to define what he considered constituted an operative lamp, giving figures to show the prohibitive expense which would attend a distribution of current to lamps constructed under any methods other than those discovered by the Edison patents.

Mr. Witter followed Mr. Dyer, for the defense. He

stated that Goebel did not approach the subject by the same path as Edison did, and that because Edison reached results by a very roundabout and difficult route, and that Goebel reached similar results through a more direct method, did not militate at all against the probability of Goebel's having reached those results, nor was the question before the court as to how Goebel reached these results, but rather did Goebel make a lamp the same in all its essential parts as the Edison lamp and one which was operative. Mr. Dyer had attempted to make the lamp appear a very complicated affair; it is not a complicated affair, but a very simple one involving an all-glass receiver, exhausted of air, a carbon filament and leading-in wires sealed into the glass receiver; this was all there was in it, and he did not feel that it was necessary for the judge to know all the technicalities which counsel for the other side had introduced that he might understand the lamp and its manufacture. He then reviewed the previous litigation, to show that although there had been a number of decisions involving incandescent lamps, there had been practically but one cause in several of the cases; the defendants were the same, but under different names. In other cases the defense made no opposition whatever. There was but one exception to this, viz., that against the Beacon Vacuum Pump and Electric Company; in the latter the nature of the case was such that a proper defense could not be made in any short period of time; no adequate time to prepare the case had been at their disposal; but three of the exhibits, lamps Nos. 1, 2 and 3 had been presented previous to argument. Lamp No. 4, upon which Judge Colt had laid such stress, had been presented in evidence subsequent to the argument. Mr. Witter then reviewed the testimony of Pope and then read the affidavits of George Teasdale, Gustave Miller, Mary Meisinger, David Hall, Julia Hall, Helen Hall, Nicholas Fink, James F. Brown, Phillip Ruhl, Sophia Stephens, Julia Zoller, Mrs. Oprey and others, to substantiate the validity of exhibit No. 4.

F. L. Pope's second affidavit was also read to show why lamp No. 4 was introduced at such a late date. The affidavits of Prof. Cross and Mr. Vandergrift, as experts, were also read as bearing on the character of lamp No. 4. At this point the J. C. Goebel lamp No. 9 was introduced as an exhibit. In regard to this, Mr. Witter stated that it had been found about the middle of February, by Mr. J. C. Goebel, the son of Henry Goebel, a few days before Judge Colt's decision in the Boston case. It was found in J. C. Goebel's house, which was in Wallingford, Conn. J. C. Goebel explained that when he found this lamp he did not communicate with defendant's counsel about it because he supposed they had all the lamps needed; when he read Judge Colt's decision, and saw that only one hairpin lamp with platinum leading-in wires had been found, he at once sent direct to Mr. Bull as to this lamp, No. 9, and at Mr. Bull's request sent it to the latter's office. This was confirmed by the evidence of the defendant's counsel, whose affidavits were also submitted. Lamp No. 9 is almost exactly the same as lamp No. 4; it has platinum leading-in wires, a filamentary carbon, made of carbonized wood fibre, undoubtedly bamboo, and a glass globe, and the air is exhausted, and it is claimed embodied the invention of the Edison patent. Pursuing his argument, Mr. Witter stated that Judge Colt evidently considered that lamp No. 4 would have been an anticipation of the patent in suit if it had been proved as prior in date to Edison's patent, but held that it had not been so proved. Lamp No. 9 anticipated the patent in suit equally with lamp No. 4, and its date could have been shown with certainty. John Goebel, in his affidavits, gives its history as follows:

In 1878, while working at the German hospital, New York City, he decided to go to Germany, and secured a passport for his use in that country (this passport is shown in evidence, and is dated June 4, 1878). He wished to take with him as a means of identification an old parchment document which had belonged to his grandfather (this old parchment is also in evidence), and asked his mother for it, but she declined to give it to him because Henry Goebel valued it too highly; instead she gave him three of his father's electric lamps to show to his father's brother in Germany, so that the latter might see what Henry Goebel had accomplished. J. C. Goebel did not go to Europe, but went back to work at the German hospital and remained there until May 1, 1879, when he went to New Haven. The time when he left the German hospital is shown by the public record of licenses granted to engineers to have been May 1, 1879. Goebel kept these three lamps; No. 9 has been in his possession ever since. These three lamps are the only lamps of his father's make that were ever given to him; two of these lamps Goebel gave to George K. Clark, about 1886 or 1887. Lamp No. 9 was kept by him (Goebel) in a trunk until about the end of 1891, when his daughter was married and took the trunk away; all the things, including this lamp, were at the time taken out of the trunk and put in other places in Mr. Goebel's house. Mr. Goebel did not remember where it had been put until it was found about the middle of February in a bureau drawer. Lamp No. 9 has therefore always been in his possession; it is in the same condition to-day as when his mother gave it to him; all three of these lamps were substantially alike. He showed these lamps to a good many persons at different times; he remembers showing them on one occasion to a number of persons at the German hospital, while he was working there, and amongst others, to Mr. and Mrs. Sebastiani. His father was also present at the time; it was before he left the German hospital, and must therefore have been before May 1, 1879, and it was on the birthday of Justine Seigfried, a woman who at that time also worked at this hospital; her birthday is on Oct. 29, so that this must have taken place on Oct. 29, 1879; during the two or three weeks while J. C. Goebel was away from the hospital, in 1878, preparing for his trip to Germany, he stayed with his cousin, Mrs. Pasbach, in Hoboken, N. J. At that time he kept his three lamps in his satchel which he had bought to take with him to Europe; he remembers showing these lamps to Mr. and Mrs. Pasbach at that time, and telling them about them and what he intended to do with them.

Baldwin Sebastiani testifies that he remembers the occasion when J. C. Goebel showed him these lamps, that it was in the fall of 1878, on Justine Seigfried's birthday, and he fixes the date by a number of circumstances; that the lamps shown to him by J. C. Goebel were just like lamp No. 9, and he believes that this lamp was one of the lamps so shown to him at that time; that these were the only electric lamps made in the form of a tube that he ever saw, never having seen any like them either before or since that day; that Goebel told him the lamps had been given to him by his mother to take to Germany.

Ida Sebastiani testifies to the same effect; Henry Goebel, Sr., also remembers this occasion and that it was in the year that his son, J. C. Goebel, had arranged to go to Europe. George Pasbach testifies that in the year 1878 J. C. Goebel came to his house in Hoboken and stayed there for several weeks while making preparations to go to Germany; that Mr. Goebel had a black satchel which he bought to take to Germany; that in this satchel he had three electric lamps which had been made by his father, and which John C. Goebel had received from his mother in order that he might take them to Europe to show to some of his relatives there. These lamps were just like lamp No. 9. Mr. Goebel explained their construction to Mr. Pasbach at the time. Mr. Pasbach believes lamp No. 9 to be one of the lamps which he then saw.

Johanna Pasbach testifies to the same effect. She saw the lamps that Goebel had at the time he stayed with them in Hoboken, and she says they were just like lamp No. 9, and she believes that is one of the lamps she then saw. "There are therefore," says Mr. Witter, "six witnesses who saw this lamp No. 9 in the possession of John C. Goebel as early as the year 1878, and who identified it and its construction. There is also a large amount of evidence showing that John C. Goebel had this lamp No. 9 in his possession for a long number of years past, part of which was given in the affidavit of Splitt (this was John C. Goebel's stepdaughter, who came to this country in 1883), who testifies that she has known this lamp, No. 9, ever since that time; that it has been in J. C. Goebel's possession since 1883. Pauline F. Thorp, a stepdaughter of John C. Goebel, testifies that she saw this lamp, No. 9, or one exactly like it, in 1889; her stepfather, John C. Goebel has had this lamp, No. 9, ever since she can remember. She remembers it for as long as 10 years. It was kept in a trunk which she took when she was married, in November, 1891. This lamp, together with all the other things, were taken out of the trunk at that time. W. B. Thorp saw this lamp, No. 9, or one exactly like it, in 1889; it was shown him by J. C. Goebel; Krumweide, John C. Goebel's stepson, came to this country in 1883. He testifies that lamp No. 9 has been in his father's possession since that time. George K. Clark testifies that about 6 or 7 years ago J. C. Goebel gave him two electric lamps, identically the same as lamp No. 9; one of these two lamps Clark set up and ran at the Bigelow company's works in New Haven in connection with a number of arc lights. It was so arranged that when one of the carbons in the arc series drew a long arc, this incandescent lamp would be lighted up. It was operated in this way for six weeks or two months, and gave a first-rate light when it was in full operation. This lamp was finally broken. Mr. Clark has lost the second lamp which Mr. Goebel gave him. In further confirmation at this point, affidavits were presented from A. H. Clark, G. W. Bigelow, W. H. W. Bigelow (the two latter respectively the brother and nephew of ex-Governor Bigelow, of Connecticut), Nevins, Trommler, Morton, Floyd and Monz. Another lamp similar in all essential respects to lamps Nos. 4 and 9 has also been found; this is the lamp marked, "Dr. William J. Mayer, lamp No. 11;" this was given to Dr. Mayer by Henry Goebel in 1885, as testified to by Mayer and Hasselbach, whose affidavits were presented. As to the construction of lamp No. 11, Pope, Monz, Rotman, Dejon, Vishno and Mayer presented affidavits.

Mr. Witter stated that Goebel had forgotten all about having made a lamp of this style, but that when it was presented he remembered that he did make some like this.

As will be seen from the accompanying cut, the base of this lamp differs from that of the others in being reentrant.

Mr. Witter went on to state that there were, in fact, a good many lamps of the Goebel make in existence, but that the defendants had been unable to obtain possession of them owing to the fear on the part of the witnesses in whose possession they are that it will injure them with the General Electric Company, if they disclose what they know. John W. Flucker, of New York City, was mentioned as an instance of this kind. He had informed defendants that before 1879 he had assisted Henry Goebel in making incandescent electric lamps, and that he knew all along that he had lamps in his possession since prior to 1879. Efforts had been made to get testimony from him, but without avail. Then attempts had been made by appeals to Judge Thayer, to compel him by law to testify; this appeal was dismissed, however. Mr. J. Edgar Bull, who has assisted in getting together evidence in the form of affidavits in this case, called upon Mr. Flucker, and learned that before October, 1879, he helped Henry Goebel make incandescent lamps, and that such lamps were made and exhausted by them in the manner described by said Goebel in his affidavit in the Beacon case; that these lamps were practically operative lamps and that at that time Goebel told him that he had been making similar lamps for years. Mr. Flucker also informed him that he had in his possession three of the old Goebel lamps made at that time by himself and Goebel, two of which have platinum leading-in wires, and one leading-in wires of a baser metal, either iron or copper; that two of the three lamps are still intact and one is broken; that these lamps have been in his possession continually since before October, 1879; that he has in his possession memoranda made at the time relating to said work, said memoranda having been made before October, 1879. Said Flucker has been repeatedly asked and urged by Mr. Bull to make an affidavit to the facts disclosed, and to let him see the lamps and memoranda in his possession; but he has persistently refused, and still refuses to do either; his reason for this course being that he is dependent upon the goodwill of the General Electric Company for the approval of electric plants which it is his business to set up at various places in the city, and in other respects, and intimated that he was negotiating or endeavoring to negotiate with the General Electric Company for the purchase of some electrical invention, or inventions, and that if he voluntarily made an affidavit concerning the facts that he is acquainted with concerning the early Goebel lamps, or showed him the things that he had, the General Electric Company would be hostile to him and he would suffer irreparable loss in his business relations with his customers. He stated, however, that if he was directed by the court to state what he knows, whether by subpoena or otherwise, he would do so for either party. He states that he has been recently many times visited by persons representing the General Electric Company, with respect to this Goebel matter.

The above testimony is that of J. Edgar Bull, subscribed and sworn to before a notary public on March 4, 1893.

Mr. George C. Crosby was mentioned as another party who had lamps and other specific evidence in his possession, but who was unwilling for some reason to make them public. In proof of this, a lengthy affidavit from Mr. J. H. Rhotehamel, president of the defendant company, was read. In this, after reciting his connection with the Columbia Incandescent Lamp Company he went on to state that he had met Crosby for the first time on Feb. 28, 1893, at the Imperial Hotel, New York City, having been introduced to him by an attorney by the name of McCarthy, who had his office in room 41, United Bank Building, New York. He had afterward met him in this latter building on March 25 and March 28, 1893. At these times Crosby had stated to him substantially as follows: That when he had reorganized the American Electric Light Company, having heard of Mr. Goebel and his work, he had looked him up, and after some difficulty had been admitted to the latter's workshop in the rear of his store on Grand street, and that there he had seen a number of incandescent electric lamps and carbon filaments, some of these being similar to those which were introduced in the Beacon case at Boston, designated as lamps Nos. 1, 2 and 3, and also others corresponding to lamp No. 4 in general appearance, being of the hairpin type. That Mr. Goebel stated to him at the time referred to that he had manufactured these lamps, some of them as far back as 1855, and others had been manufactured covering a period up in the seventies. That he asked Mr. Goebel to give him a number of these lamps, which he did, and that he, the said Crosby, now has in his possession and has had ever since then these said lamps; that he mounted them on a cardboard showing the date at which Mr. Goebel said they had been made by him, and showing also the date when he, the said Crosby, had received them. He said that he had had some of these lamps burning, and that they were successful incandescent lamps, embodying all of the second claim of the Edison patents, and that some of the lamps compared very favorably with the present incandescent electric lamps as to light-giving qualities; that some of them had iron leading-in wires and he thought that one had silver leading-in wires, and that a number of them were made with platinum leading-in wires. That he made an arrangement with Mr. Goebel to make carbon filaments for the said American Electric Light Company, and that the lamps and filaments produced by Mr. Goebel were very much superior to the lamps that they had been previously able to make and

that they were superior to the then Edison lamp. Mr. Goebel had anticipated Edison in the invention of the incandescent electric lamp for the reason that he showed such a great knowledge of the business when he first became acquainted with him, and was also able to produce superior lamps to those of Edison. He (Crosby) said that he thought that these exhibits were of great value to the defense in the pending lamp litigation, and that he would not be willing to make an affidavit in the case disclosing all these facts and produce these said exhibits unless he should be paid what he thought the said exhibits were worth, which he stated would be a very large sum.

"I requested him to make an affidavit in the case setting forth all of these facts recited to me by him," said Mr. Rhotehamel, "even though he did not produce the exhibits, but this he declined to do. He said that his testimony was important from the fact that he was the only person connected with the said American Electric Light Company who had any dealing with Mr. Goebel, and that the statements made by the McMahons in their affidavits filed in the Beacon case were false, and that the McMahons had no means of knowing what had been produced by Mr. Goebel.

He further stated that he did not want pay for making an affidavit in the case, but he thought that the exhibits were of very great importance and that he would not make the affidavit unless we should make some arrangement to purchase the exhibits. He did not then name a price that he wanted for them, but stated it would be a very large amount which I have since learned was $100,000.

Great emphasis was laid upon this affidavit of Mr. Rhotehamel, for it was contended that had testimony of this kind been available to Judge Colt, his decision would have been otherwise.

Mr. Witter went on to state that if Goebel had done what was claimed we would naturally expect to find those who would have said at the time of the great excitement over the Edison lamp, "Why, that is not new; Edison has been long anticipated in his work by another." "We have indeed found such a person in Emil Seidel," said Mr. Witter.

The affidavit was then read of F. Herbert Palmer, that he had obtained an affidavit concerning Henry Goebel from Emil Seidel, whom he had found at his place of business, namely, that of the E. P. Gleason Manufacturing Company, 20 West Houston street, New York. He goes on to state that in the affidavit made by Mr. Seidel he states that about the time when there was so much talk about Thomas A. Edison as the inventor of the incandescent lamp, he spoke to Mr. E. P. Gleason, now president of the E. P. Gleason Manufacturing Company, about the matter, and told him that he knew a man who had invented the incandescent electric light years before Edison ever thought of it; that he also stated in his affidavit that he made the same or substantially the same remarks to Mr. E. M. Gennert, also connected with the E. P. Gleason Manufacturing Company. Mr. Palmer states that on Feb. 16, the day following, he went to see Mr. E. P. Gleason, and after talking with him on the subject wrote out the statement annexed hereto and marked Exhibit "A," and asked Mr. Gleason to read it over and swear to it. Mr. Gleason read the paper through and said that the statements contained therein were true, but that he did not feel that he ought to sign the paper, as the E. P. Gleason Manufacturing Company received large orders from the various Edison companies, and he did not wish it to appear that the E. P. Gleason Manufacturing Company was taking a position at all hostile to the Edison people's interests. He said, however, that he would call a meeting that evening of the directors of his company, and would lay the matter before them and obtain their opinion as to whether he ought to sign such a paper as this or not. The next morning he again called upon Mr. E. P. Gleason and found that the directors' meeting of the company had been held the evening before and the directors were all opposed to his signing any affidavit. In consequence thereof, Mr. E. P. Gleason refused to sign the affidavit.

On the afternoon of Tuesday, Feb. 21, Palmer called at the E. P. Gleason Manufacturing Company again and saw Mr. Gennert. He asked him if he remembered Emil Seidel speaking to him at the time such a stir was made concerning Edison's invention of the incandescent lamp, and telling him of a friend of his who had made the invention years before Edison thought of it. Mr. Gennert said that he remembered such a conversation with Emil Seidel. He then asked him if he would sign an affidavit to that effect, and he said that he would not, for the same reason that Mr. Gleason had stated in refusing to sign an affidavit, namely, his fear of disrupting the friendly relations between the Gleason company and the various Edison companies. Mr. Gennert told him that at the time of the appearance in the New York "Herald" of the famous "Herald" article concerning the incandescent light of Thomas A. Edison, he jokingly went up to Seidel, who was then in the employ of the Gleason company, and told him that there would be no further need for gas and oil lamps, as a man named Edison had discovered a new light which would be the light of the future. Mr. Gennert said that he believed this "Herald" article appeared some time during the winter of 1879 and 1880; that he then explained to Seidel the light which Edison had invented, and believed that he made a sketch of the lamp for the purpose of explanation. Seidel then said that the whole thing was old; that he knew of a man named Goebel who lived over on the east side of town, near Grand street, who had made these things long ago. Mr. Gennert said it was his recollection that Seidel told him that he remembered seeing these lamps before the war; Mr. Gennert stated that he was the superintendent of the Gleason Manufacturing Company, and he (Palmer) believed that he was a director also.

EXHIBIT "A."

E. P. Gleason, being duly sworn, deposes and says: "I am of lawful age and am president of the E. P. Gleason Manufacturing Company, of 20 West Houston street, New York City; the E. P. Gleason Manufacturing Company is generally acknowledged to be the leading manufacturer of gas fixtures and similar articles in this country. I am personally acquainted with Emil Seidel, who has made an affidavit dated Feb. 15, 1893, concerning Henry Goebel. I have known Mr. Seidel for many years; in fact I knew him before we moved our business to our present building in 1873. I remember that at the time such a stir was made about T. A. Edison as the inventor of the incandescent electric lamp, which was, I think, about the year 1879 and 1880, Emil Seidel remarked to me about this invention and said in substance that he was acquainted with a man who lived somewhere on the east side of this city who had made lamps like Edison's years before Edison ever thought of it."

The affidavit of Emil Seidel to which reference has been made was then read and was as follows:

AFFIDAVIT OF EMIL SEIDEL.

Emil Seidel, being duly sworn, deposes and says: "I am 51 years of age and reside at 1006 Washington street, Hoboken; I am acquainted with Henry Goebel, who at one time resided at 271½ Monroe street. I have known him ever since the marriage of my sister in 1858 or 1859. I used to call quite frequently at Mr. Goebel's house in Monroe street to see his daughter, Sophie Goebel, and, of course, I frequently talked with Mr. Goebel. I distinctly remember that in one of my conversations with Mr. Goebel he showed me an electric lamp. It consisted of a cylindrical, tubular glass chamber enclosing a fine black wire-like substance. This black wire-like substance he pointed out to me, and I remember distinctly that he said in German, 'It looks like a saw.' This lamp he showed me was of the 'meat-saw' variety. It was connected by two wires to batteries, and when Mr. Goebel would join the wires the lamps would light up. This lamp which Mr. Goebel showed me burned quite brightly, brightly enough to read by. Mr. Goebel did not keep it burning very long when I saw it, because, he said, it cost too much. On the same evening when I saw this meat-saw lamp I remember seeing a very brilliant electric light that he had on top of the house. This light was very brilliant indeed. I remember Mr. Goebel spoke to me about using platinum in making the meat-saw lamps. He said it was extremely expensive and he was experimenting with something cheaper. I am now in the employ of the E. P. Gleason Manufacturing Company and I remember that the company moved in its present place of business at 20 West Houston street, New York, in the year 1873. I know that before we moved into this place of business I called upon Henry Goebel in his shop in Grand street, and saw some electric lights burning in his shop. Mr. Goebel occupied two houses in Grand street; I am now speaking of the first house he moved to. There were two lamps in the back of the shop placed over work benches. These lights were used to work by, so Mr. Goebel said, for I remember I went there in the evening and it was dark in the back of the shop and Mr. Goebel turned them up to light the shop, saying he used them to work by. After Mr. Goebel moved from Monroe street I did not visit him very often, as I was then married and did not go about so much. These lamps I saw before 1873 in Mr. Goebel's Grand street shop were much like the meat-saw lamp except that the filament inside the lamp was in the shape of a hairpin instead of a meat saw. The meat-saw lamp which I saw in Monroe street was exactly like the cut marked 'Goebel's carbon filament lamp of 1859.' I went to the war in 1861 and I remember that I saw this lamp before that time. I stayed in the army a little over two years. I remember that when Mr. Goebel moved to his second shop in Grand street I also saw some of these tubular shaped lamps and I saw them long before he commenced to make a business of making lamps. He subsequently had a dynamo and other machinery and regularly went into the business of making these electric lamps. He made them at this time in pear shape. I remember that Mr. Goebel in the early days used to exhibit a telescope and Mr. Goebel told me he had batteries in the wagon upon which his telescope was mounted to light up his telescope with, but I never saw the lights myself.

"About the year 1879 or 1880, when such a stir was made about Edison incandescent electric light, I remember telling Mr. Gleason and Mr. Gennert, of the Gleason Manufacturing Company, that I knew a man who had invented the incandescent light years before.

"I think I must have been in Mr. Goebel's shop as much as once a year while he was in Grand street, and I always saw these tubular-shaped electric lamps.

"Mr. Henry Goebel is an honest man. I would believe anything he said. His reputation is of the best among those who know him."

Mr. Witter then stated that the plaintiffs had claimed that the witnesses of the defense were not those whose testimony could be relied upon in regard to matters of detail such as were necessarily involved in the identification of the early lamps of Goebel. To controvert this, he read the affidavits of several witnesses who he was sure were competent in this matter. Among these were William Hinton, who had worked for the American Electric Light Company and was very familiar with both Goebel and his lamps. The affidavit of the venerable Peter H. Vander Weyde was read, which stated that he had frequently seen the lamps of Henry Goebel prior to 1860; that he was much interested in them as a scientific man and corroborated many of the statements made in Henry Goebel's affidavits in the Boston case.

It may be stated in this connection that while Mr. Vander Weyde's affidavit was very positive and specific in character and occupied five pages of printed matter, he also subsequently made an affidavit for the plaintiffs denying that he made many of the statements contained in his first affidavit, and stating that he signed same without reading it, assuming it to be correct.

In rebuttal of this statement Mr. Witter read an affidavit by Mr. Alan Kenyon to the effect that he had read Mr. Vander Weyde's affidavit to him very carefully, that Mr. Vander Weyde had then himself read it very carefully previous to signing it, and Mr. Witter stated that he also had gone over the whole affidavit personally with Vander Weyde, section by section and that there could be no question but that at the time Mr. Vander Weyde signed the affidavit he was familiar with every statement contained therein and knowingly indorsed it.

A large number of affidavits was then read to show the character of Henry Goebel and the statement was made that of all those in evidence, there was but one of an unfavorable nature and this would be referred to later. In conclusion, Mr. Witter called attention to a series of reasons why the testimony gave self-evidence of its truth, chief of which was that voluminous as it was, various as were its sources, it still hung together.

Among the exhibits presented by the defendants were several planers which Henry Goebel had constructed for reducing his bamboo filaments. One which he had claimed to have made could not be found and Henry Goebel had been requested to reproduce this missing planer to the best of his recollection. He had reproduced it and this same was in evidence. Later, the missing original had turned up. This too had been placed in evidence and the similarity between the original and the reproduction was so marked as to be a monument to the honesty of Goebel's mind and this incident in itself should be conclusive evidence of the truthfulness and simplicity of his character.

The defense, Mr. Witter said, had presented about 150 affidavits as to the fact of Henry Goebel's having made and used these lamps. These statements of fact were met by the plaintiffs solely by the mere statement of opinions, either that Goebel could not have done what was claimed, or by the testimony of those who claim to have lived in Grand street or elsewhere and to have known Goebel and to have seen his telescope wagon at various times, or to have been in his stores, but who did not see the electric lamps which he claims to have made. Such testimony which is of a purely negative character, certainly could not destroy or outweigh the testimony of 150 or more credible witnesses who state positively that they themselves did see on one or more occasions the lamps claimed to have been made by Henry Goebel and to have seen those lamps illuminated.

Mr. Witter closed his argument early in the afternoon and was followed by Mr. W. H. Kenyon, also of the defense.

Mr. Kenyon stated that he realized that the court had before it a serious question, one which had never before been decided or passed upon by any court, viz., one of infringment as against the Edison patent.

"It had been rendered more indefinite by the peculiar wording of the Edison claim, which Judge Wallace had some difficulty in interpreting the meaning of in order to find out just what the patent covered. Judge Wallace had gone into the history of the art to find out what the state of the art was previous to the issue of this patent to Thomas A. Edison. In this search into history and by the evidence at hand he came to the conclusion that the state of the art did not involve what was afterward defined a filamentary carbon. The plaintiff in this case claims that, according to Judge Wallace's opinion, claim 2 of the Edison patent covers the fundamental invention of a filamentary carbon burner sealed in a glass vacuum chamber, while the defendants claim that unless the wording is confined to very narrow limits it is invalid for want of novelty. As before stated the whole of the opinion of Judge Wallace was based on he state of the art prior to the Edison patent as presented *at that time.* If it should turn out that the state of the art as so presented was not the true state of the art, as we maintain is the case, and that it turned out, as we claim it has turned out, that prior to Oct. 12, 1879, there existed in the art a lamp different from anything proved or studied by Judge Wallace—materially different—then his decision would have been different. All adjudication previous to this case is binding only to the extent of the facts determined and presented in those cases If we show that the state of the art as then

presented was not the real state of the art, then the case must be heard upon its individual merit. Judge Wallace himself states that the specifications were perplexing. and to determine them he must look into the state of the art. From the evidence presented the points of novelty decided upon were narrow. Referring to the Edison patent and to the drawings 1, 2 and 3, we observe of the carbon filament A that it is coiled. In the preamble, first column, Edison stated that this filament consists of a *light-giving wire coiled*, and he states that the reason for coiling it was to prevent high radiation and to attain high resistance; this patent therefore involves a specific arrangement of the filament. The court in New York ruled against this narrow construction, however, simply because it failed to find in the state of the art a carbon filament as an illuminant. Everything else—the vacuum, the all-glass receiver, the platinum leading-in wires fused into the glass—was old. Judge Wallace said that the nearest approach to the lamp in question was Edison's own French platinum burner, and stated that the carbon filament was the step which Edison had taken and which constituted the invention. We have shown overwhelmingly that we had a filamentary carbon, and that it existed in the art and was used as an illuminant. Judge Wallace therefore held for us inferentially that if such a carbon did exist in the art it would have been no invention on the part of Edison to have substituted it for platinum wire. The court may therefore dismiss everything else in this case, in our opinion, and concentrate his attention solely upon the question, Is there evidence by which the defendant can prove in the final hearing that there was a filamentary carbon in the art prior to Oct. 12, 1879?"

Mr. Kenyon then read to the court the definition of a filament as previously defined in Judge Wallace's opinion, requesting the Judge as he read the definition to hold in his hand the Goebel lamps Nos. 4 and 9, that he might see how far the filaments therein contained conformed to the definition as read.

In the case under Judge Wallace, $\frac{1}{32}$ inch diameter was the smallest carbon shown to have existed in the art prior to the Edison patent. This was not a filament.

Speaking of the Goebel exhibit lamps, Prof. Cross and Mr. Pope say that they show as the illuminating part filaments of carbon that are the "carbon filaments" of the Edison claim, and Prof. Thomson does not deny this. They also give the dimensions and indicate the place in Prof. Barker's table of these Goebel filaments. Stated in terms of the diameter of a circular cross section, the important carbons of that table and of this case are, after carbonization, as follows:

FILAMENTARY BURNERS.

Tar putty wire of patents	.005
United States "Tamadine" lamp	.006
Beacon lamp	.007
United States "Zigzag" lamp	.008
Goebel lamps	.008 to .010
United States "M" lamp	.013
Patent Office model	.015
Largest cotton thread	015½

ROD BURNERS.

Sawyer-Man, smallest	031
Millimetre carbons	.040
Sawyer feeder lamp	.050
Adams, accidentally small	.050
Koun	.063
Adams lamp	.057

The United States "M" lamp in the prior case was, on the construction there given to the claim, held to infringe. Clearly the Goebel lamp, if used to-day, would, on the same construction of the claim, be held to infringe. The question, therefore, of its prior use is crucial.

The defense is non-infringement, a question not passed upon except hypothetically by Judge Wallace, who said that if the prior art showed a filamentary carbon, Edison made no invention.

Judge Colt's decision does not affect the case. The case now made was not before Judge Colt.

The defendants presented a list of witnesses who state that this carbon did give light prior to Oct. 12, 1879. There are 18 in all. Not one of these has been discredited as to veracity and only two have been questioned and all but two or three of these witnesses were outside of the Goebel family. No witness on the other side says that the thing Goebel made incandescent was not carbon.

They also present a list of those who of their own knowledge testify of the filamentary character of this carbon. There are 16 in all, only 3 or 4 of the Goebel family.

As to those who testify as to the carbon and as to it filamentary character, 10 or 11 also testify as to the vacuum, only 4 of these being of the Goebel family.

Four witnesses testify that he had a pump before Edison received his patent.

SUFFICIENCY.

The defense is attacked on the ground that all of their lamps produced are broken and cannot be operated. It is theory or supposition against facts. Our witnesses state what they know.

Before Judge Colt, lamps 1, 2 and 3 were the only lamps argued. No. 4 went in a week after arguments were closed. It was contended that lamps 1, 2 and 3 could not have operated because they had iron or copper leading-in wires.

Prof. Thomson's affidavit was cited, in which he stated that in his opinion 1, 2 and 3 could not be practically operated because copper and iron were used as leading-in wires.

Pope said that iron of all the metals stands next to platinum in its similarity of coefficient of expansion to glass and believed it would be perfectly feasible to make operative lamps with iron leading-in wires.

The defendant had Mr. Edward E. Cary make some lamps withiron leading-in wires and also one with copper. These are known as Cary iron lamp A. It burned 245 hours. Cary iron lamp B burned 208¼ hours; Cary copper lamp C burned 211 hours; Cary iron lamp D burned 195 hours; Cary iron lamp E burned 193¼ hours. and some of them were still burning when the report was made.

They also had Mr. Goebel reproduce some of his old lamps. There are marked "Goebel reproduced lamps A, B, C and D."

These lamps were made by Mr. Goebel without any assistance or direction by any one else, but his work was carefully observed by the witnesses, McOuat and Edward Carey. That these four reproduced lamps are good operative and durable lamps is fully shown by the evidence of Pope, McOuat, Cross and Cary. Three of these were tested for life by running them continuously at normal incandescence. One of these ran 166 hours, one ran 87¼ hours, and another 45¼ hours.

To meet this testimony Prof. Thompson makes another affidavit, in which he says that now that he understands the difficulties he admits that iron can be used Thus Prof. Thompson's opinions have been proved by experiment to have been worthless in every respect as far as they touched the practicability of these lamps.

Calling attention to the second claim of the Edison patent, Mr. Kenyon shows that it says nothing about platinum leading-in wires, but merely speaks of conductors. Iron is a conductor as much as platinum is; in fact, is a much better conductor. Therefore, if the use of platinum leading-in wires would be an infringement, the use of iron or copper for the same purpose would also be an infringement or their use prior to 1879 would constitute an anticipation.

In the case before Judge Colt, an attack was made on the sufficiency of the Torricellian vacuum. In regard to the Torricellian method, Prof. Cross says that it is a well-known method of producing a high vacuum, and would give a sufficient vacuum to produce a practical lamp.

Reading from the final hearing in the New York case on the Torricellian vacuum, Dr. Morton says that even to day, if produced with proper care and skill, it would be a very efficient vacuum. We have seen that Goebel not only possessed the skill, but used the proper care, for he filtered his mercury and then distilled it and redistilled it.

Prof. Brackett, an Edison expert, says the Torricellian method was the best practical method known up to 1845. It is submitted that if Goebel used the best method known to the world to produce a vacuum, and thereby succeeded in making a practical lamp, that he has answered these objections.

Clark, the principal Edison expert in the New York case, says that the Torricellian method is much better than the piston air pump. Goebel found this out by experiment thirty years before. Clark says that a vacuum of one thirty thousandth of an atmosphere may be obtained by the Torricellian method. He also testified that the vacuum used in the Edison lamp was about one thirty thousandth of an atmosphere. This was in 1890 and 1891. As before stated, the defendant has made lamps with this Torricellian vacuum, and Goebel has reproduced some of his old lamps by this same method.

Mr. Cary says in regard to these four Goebel reproductions: "I have been in the business of making incandescent lamps since 1885 and am thoroughly familiar with the commercial art and with the many forms of lamps that have been put on the market. In my opinion the Goebel reproduced lamps, A, B, C and D, are entirely capable of practical use and are entirely operative and useful lamps to-day and were so when the originals were made prior to 1879, as stated by Mr. Goebel. I have read the Edison patent in suit No. 223,898 and believe I understand the construction of lamps there referred to. In my opinion not one of the many forms of lamps there described could be successfully made, or, if made, could be practically or successfully used or would be capable of any practical use whatever, either now or when the patent issued. The lamp features and lamp construction shown in Goebel reproduced lamps A, B, C and D, and especially in D, are a great advance on anything shown in the said Edison patent, and where the latter could fail of any operative usefulness at all, the former would operate successfully and be useful for practical purposes."

The charge, therefore, that a successful lamp cannot be made with the Torricellian vacuum must fail, for of four lamps thus made one burned 45 hours, one 87 hours, and one burned 166 hours.

These are the results, but these results are attacked; but if Goebel made a lamp prior to 1879 that lasted 166 hours was not this a practical lamp?

Mr. Kenyon then called attention to the testimony as to the want of success of lamps made exactly according to the Edison patent. Mr. Edison in his Canadian affidavit sets forth in most emphatic manner the difficulties even he himself had encountered, even as late as 1886, in making his lamps. He states that "the lamps made in France for some time were commercially a failure," and that in Germany "the same difficulties were experienced as had been experienced by the French company," and for some time "the lamps were a complete failure from a commercial point of view."

The U. S. Record shows that the early lamps made under the Edison patent were worthless, commercially, although they embraced all the improvements known to the public.

In April, 1880, Prof. Rowland, of Johns Hopkins University, and Prof. Barker, then and to-day an Edison expert, published in the "American Journal of Science" an acconnt of the tests which they made with the Edison lamp. Among other things they say: "Provided the lamp can be made either cheap enough or durable enough, there is no reasonable doubt of the practical success of the light *but this point will require much further experiment before the light can be pronounced practicable.*"

The Edison patent No. 223,898 mentions four different materials out of which to make the burner, viz., tar putty, thread, wood splints and paper. The testimony as to the inoperativeness of each and all of these materials used by Mr. Edison in his early manufacture is overwhelming.

Of the tar putty burners Batchelor, an Edison expert, says, "They were not sufficiently practical to put out as a commercial lamp." He further says that as a matter of fact no tar putty lamps were offered for sale or given to the public use.

As regards lamps with burners of cotton and linen thread, Batchelor, Edison's chief witness, says, "They were not considered by us as commercial lamps in any sense."

In regard to burners made of wood splints, Mr. Edison himself says, referring to his early work, that "We soon found out in our experiments that filaments could not be successfully made from wood. All lamps we made from this class of material were of no use whatever." He was here speaking of exogenous woods. He later found that endogenous woods of certain kinds answered his purpose. Of oxogenous wood Edison says, "I am not aware of an exogenous wood which would make even a fairly operative lamp."

In answer to question 438—Would an incandescent lamp having a filament made from wood of exogenous growth be, in your opinion, a practical lamp? he replied, "Not with any woods that I know of." Batchelor said in regard to exogenous woods, "I consider them practically worthless;" and again he said, "We have never succeeded in making an incandescent lamp having an exogenous wood as the arc of the burner, which could by any stretch of language be called a commercial lamp."

That Mr. Edison referred to woods of exogenous growths when in his patent he used the term "wood splints" is shown by his own testimony. He says:

"429 Q. As I understand you, in speaking of woods, you mean exogenous vegetable growths?

"A. Yes: that have medullary rays or right angle fibres."

Of lamps having burners made of paper, it abundantly appears that Mr. Edison and his assistants made many experiments with paper of various forms.

Batchelor, when pressed on cross-examination as to the commercial success obtained with paper carbon in lamps, says, "We thought it worth while and did, follow it up, and *proved it of no commercial value.*"

It was only after Mr. Edison had tested his 6,000 kinds of vegetable growths, and thereby discovered some five or six kinds that were *not* embraced in the classes named in his patent, that he was able to produce a truly commercial lamp. On this new material (being a wood of *endogenous growth*, bamboo) he took a broad patent, No. 251,540, on Dec. 27, 1881. This is *not* the patent it is claimedhas been infringed

Surely no tests should be applied to the Goebel lamps to-day to determine their commercial success which the Edison lamps could not stand then, nor is the commercial success of a patent controlling.

It is claimed for Edison that one month after the issue of his first patent—the one in controversy—he invented the bamboo after everything covered by the first patent had failed

Goebel had been using bamboo for 20 years before Edison's first patent had been applied for.

After two years of experience Edison took out another patent in which he stated that he had discovered that a *high vacuum* was destructive of the filament. (It will be noted that the Goebel lamp is declared inoperative because it did not have a high vacuum) Mr. Kenyon here called the attention of the court to the blackening of Goebel lamps No. 2, which he said was silent but conclusive evidence of two facts. Reading from Edison he stated that he found the amount of the deposit in any given period depended upon the degree of incandescence, and that the higher the vacuum the greater the deposit. This blackening, therefore, attested to the facts that Goebel lamp No. 2 had been highly incandescent and that there had been a high vacuum.

Returning to Prof. Thomson's evidence in the New York case, to the question, "Would it be practicable, in your opinion, to make a lamp outside of the Edison patent?" He replied, "It would not." Other testimony of Elihu Thomson's was cited to show how often his opinion had been erroneous and how little reliance could be placed upon it. He then read the testimony of Prof. Chas. R. Cross and of Edward E. Cary, whose testimony, he said, had remained uncontradicted.

Proceeding, Mr. Kenyon said that the commercial art to-day was not indebted to the Edison patent, and went on to show that a practical lamp depended upon many things

besides the lamp, quoting Edison to this effect, and stating that the lamp in question was not the lamp of the patent, but a subsequent one.

He claimed that Edison was *not* the pioneer in the art: That he was entitled to have a patent on the particular lamp with a coiled filament specified in the patent only.

Goebel's lamps were criticised because they were not uniform in voltage. The Edison lamps of to-day are not uniform.

It was claimed that Goebel never made any practical use of his lamp. What constitutes practical use? Brush vs. Condit was cited, where it was determined and held that the making of a single arc lamp at Ansonia, which was in existence but seven weeks, and used but for a single purpose, and then dismantled to furnish material for another experiment, constituted a practical use, and on the testimony of a single person of this fact the Brush patent had been thrown out.

He maintained that if Goebel had come here with the single affidavit—"I made a single lamp that I used on some occasion, I don't remember what, but I used it"—then our case would be on the same footing as in Brush vs.

GOEBEL EXHIBIT NO. 4.

Condit, in which the United States Supreme Court ruled that a single case of use constituted anticipation.

It is claimed that all that Goebel did he abandoned.

"The law is that after one machine has been made complete and operated and then abandoned, it goes to the public." "No man, be he Edison or anybody else, can ever after maintain an invention involving that abandoned, even if its use be entirely different from that originally intended."

This allegation of abandonment, he maintained, was immaterial, for if Goebel's invention had been abandoned it was then public property, and Edison's patent was invalid; but there never had been an abandonment. As the case appeared before Judge Colt there was a suspicion of abandonment, but this had been removed by the new testimony.

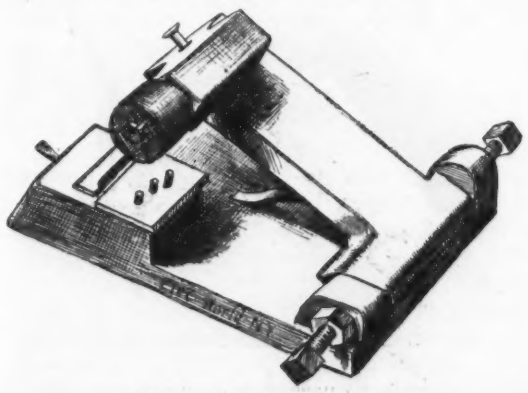
It is claimed that Goebel's work amounted to nothing because Goebel did not understand the question of the subdivision of light or the correlation of light, heat and electricity.

It was maintained that this criticism was wholly immaterial. If Goebel made the thing, then Edison is not entitled to a patent on the thing—reasoned he ever so wisely. Nor is it invention to use an old machine for a new purpose.

The Lodyguine and other lamps referred to by Mr. Dyer the court in the New York case had ruled out entirely because in them was not involved the filament.

"Now have we proved our facts? If so, they alone are sufficient. We present affidavits of those who *saw* it done, of those who *did* it, of *those for whose benefit* it was done, of those who had no interest in stating falsehoods."

Mr. Kenyon maintained that previous adjudication did not apply to this case. "Never," said he, "until two months ago was the defense as now made known to mortal man. Therefore it was not in the previous case."



GOEBEL EXHIBIT NO. 6.

He then went on to show why the Goebel testimony as known in the early litigation and history of the art was not made use of. The American company finally acquired the Sawyer-Man patents, which they believed controlled the situation. The Westinghouse company, Curtis, Prof. Thomson and others were interested in these patents. They believed that these patents would defeat the Edison patents; it was two great organizations fighting each other to see who should obtain the monopoly. Much as those interested in the Sawyer-Man patents desired to break the Edison patents, they were unwilling to break them by sacrificing their own, and they had no interest in proving Goebel's claims true, if by so doing they invalidated their own patents. Prof. Thomson admits that for seven years he was interested in sustaining the Sawyer-Man patents. Why, then, should he be interested in proving Goebel's claims true?

The attacks on Goebel's reputation were then refuted, the Deacon pumps and the Hetzel, Dreyer and the McMahons' statements being particularly referred to, and Kuhlenkamp was referred to as a forger.

"The fact is," said Kenyon, "either this defense of ours is all a vast fabrication or our facts are proved substantiating a dozen times over that we do not infringe."

Mr. Kenyon closed by showing the circumstances under which Judge Colt found it necessary to decide as he did—there had been previous adjudication on the same case and he decided it necessary to postpone to final hearing the final decision. "It was Colt's duty," he said, "to defer decision until final hearing. The law so reads.

"The complainants did not come into court with clean hands.

"We have not only broken down the presumption of the patent, but we have broken down the patent itself by incontrovertible proof.

"There has been no public acquiescence in the Edison patent. There has been the greatest opposition to the Edison patent—not to the coiled filament, for that is the patent, but to the broad construction of the patent. You will be told that this is not so and will be referred to the licensees—these are the agents, the fingers and toes of the great octopus.

"You will be told that the patent expires next year and that it makes but little difference to us whether we are enjoined or not. You will be told that we are wholly to blame for the condition in which we are placed. The answer is that the plaintiffs did not attempt to defend their patent until five years (May, 1885, Dyer) after issue of patent, yet flagrant infringements were all the time being publicly made. Edison was in that interval claiming in the Patent Office that his patent did not cover the ground broadly, but was trying to get a broad claim.

"Again we tell you that the patent is as likely to last until 1897 as to expire next year, as the plaintiffs will admit that there is a case now before the Supreme Court, which they have great hopes of winning, which, if decided in their favor, will extend the life of this patent until 1897."

Mr. Witter then arose and said: "The Court having asked for a list of affiants related to Henry Goebel, I request that the plaintiffs also be asked to hand to the Court a list of their affiants who are connected in any way with the General Electric Company or their licensees."

MR. SEWARD'S ARGUMENT.

It seems proper to correct two erroneous impressions to which the opening argument may have given rise. First as to the construction of the patent.

We supposed it was settled finally and conclusively by the final decision. Edison uses this language: "Platinum only can be used because of the similarity of its coefficient of expansion with that of glass." This should not leave the impression that the use of iron would be an anticipation.

Second, that the patent ought to be limited to the spiral form of filament. Edison speaks of the unsteadiness of dynamos, which is unavoidable, and the necessity of counteracting this in the lamp in some way. He says that it is counteracted in a large measure by the spiral form of filament, and suggests this as a preferred form as is required by law, but does not limit himself. In speaking of the previous custom of the use of rods, he says that he has reversed this practice of low resistance and that he has discovered that in high *vacua* the carbon was stable. The stability of carbon in high *vacua* is therefore the foundation of the second claim. He stated that the Court had already passed on the Goebel matter, and that this was not a new case, as claimed by the defendants at all, as all the questions had been previously adjudicated.

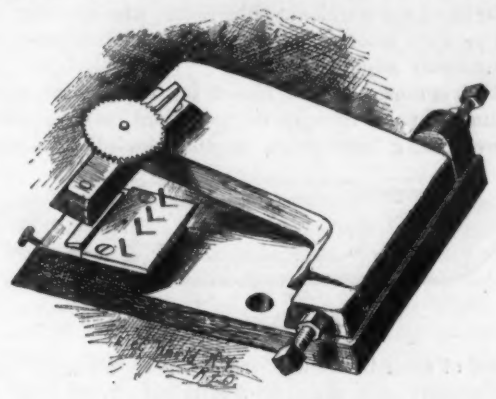
Referring to the customs of the Courts, he stated that the Court first having acquired jurisdiction should retain that jurisdiction, and that a case of this kind which had previously adjudicated should not be reversed by another Court of the same standing. The defendants had a remedy, namely, to say to the Court in Massachusetts that they desired to be heard.

This case presents no facts which did not characterize the previous case, it is true. If there was ever anything illusory ever presented, it is that anything has been proven in this case that was not proved in the former one. The bringing of more witnesses is not new proof. But the defendant in Boston acquiesced in the injunction. It is now for the Court to decide what effect that injunction has, not only upon this defendant, but upon the subject matter of that defense.

Our belief is that Goebel never had anything to do with incandescent lamps until after he went into the employment of the American company in 1881, and that all he did previously was with arc lamps and with platinum lamps. The court might just as well understand that this is the position of the plaintiffs, and that they think that the affidavits of the defendants themselves prove that Goebel never had an incandescent lamp until he was employed by the American company. Mr. Seward then went on to state in various ways how it seems that the Goebel evidence had been manufactured from time to time as needed to fill in the gaps. He then took up the affidavits offered by the defendant and examined them critically. Referring to Rhotehamel's affidavit, he said that supposing Crosby had sold his lamps to the defendant, still the whole thing would depend upon Goebel's word that he had made those lamps—nothing would have been proved.

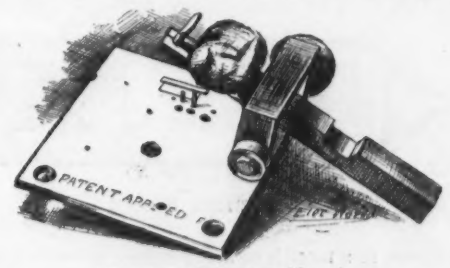
In 1881 Goebel says he never had made an incandescent lamp, but that he could make them look old, and he never denied this statement. Goebel fixes the date of Lamps 1, 2 and 3 by the date of introduction of gas on Monroe street. These lamps were made without the use of gas; therefore they were made before gas was introduced in Monroe street. There are six lamps in evidence, numbered 1, 2, 3 4, 9 and 11, said to have been made by Goebel. If Goebel made as many lamps as he claimed to have done, why cannot more be found? And of all these lamps in evidence, there is not one which is to-day in condition to illuminate, nor is there one witness, except Henry Goebel and John C. Goebel, who states that they ever have been illuminated. They cannot be illuminated and never could be. If these defendents think they can use iron or copper for leading-in wires they are welcome to use it.

There is no positive identification of any of the lamps except by Goebel's son, who could have been only 17 years old when he saw them in Monroe street. The most positive



GOEBEL EXHIBIT NO. 7.

witnesses, including Goebel himself, state no more than that the lamps they saw were just like or similar to the ones in question. Speaking of Lamp No. 4, he stated that it was a comparatively perfect lamp and that the defendant claimed that it was an improvement over lamps 1, 2 and 3. He then quoted Judge Colt's opinion in regard to the genuineness of the lamp, and would not admit that the new testimony in regard to 9 and 11 established the genuineness of No. 4. The fact that No. 4 ever burned and gave light is testified to only by the two Goebels. In regard to lamp No. 4, he read the testimony of Charles H. Reinman, which stated that the glass support for the leading-in wires there used was his own invention, made in 1881. If this be true, then Goebel's testimony is discredited in one important fact, and if thus discredited in one particular is discredited entire. The defendant finds that there are defects in lamp No. 4, but do not state where they are. They believe, or claim that they believe, that the defects were caused by use or jar, but he himself believes the defect to have been congenital. Goebel claims to have made No 5 while he was with the American company. No. 5 is a verification that Goebel never knew until 1881 what constituted an incandescent lamp. Referring to the tools presented as exhibits, he stated that the planer marked "Goebel, No. 6" was claimed to have been made in the 1860's, that marked 7 to have been made before 1870, that marked 8 to have been sold to Perkins in 1886. He believed that these were produced to supply a gap under the stress of Judge Colt's opinion. Referring to lamp No. 9, Mr. Seward maintained that its identification was indefinite; that it depended solely upon the statement of Henry Goebel and that of J. C. Goebel, both of which were indefinite. Lamp No. 11 has this history: W. J. Mayer says he called upon Goebel in 1885, and that he, Goebel, gave him one of his *old* lamps. This is all the testimony we have. Henry Goebel only says: "I recognize the carbon as like that I made prior to 1879." To substantiate this statement that he believed Goebel only to have experimented with arc lamps, Mr. Seward read considerable of the testimony of the witnesses of the defendant to show that if their language did



GOEBEL EXHIBIT NO. 8.

not specifically state that what they saw was an arc lamp or a platinum lamp, it was such as to be capable of that interpretation fully as much as that placed upon it by the defendants. As to the character of the witnesses for the defendant, grouping them by their ages at the time the events transpired of which they testified, five may be classed under the head of old age; two were two years old; three, five years; one, five to eight; one, six; one, seven; one, eight to sixteen; one, nine; one, nine or ten; three, ten; three, eleven; four, twelve; five, thirteen; three, fourteen; three, fifteen; four, sixteen; five, seventeen; two, eighteen; four, nineteen; two, twenty-three; two, twenty-four; one, twenty-five; one, twenty-seven. Goebel says his lamp was ready for commerce, but that commerce was not ready for the lamp. It has been claimed that Goebel does not speak good English. That sentence is pretty good English, but is not the truth, for since 1871, commerce had the current, but not the wick, for as early as 1871 a patent for a dynamo was the subject of litigation in the United States; so the current was there, but the wick was not found until Edison discovered it in 1879.

At this point Mr. Seward presented five lamps in evi-

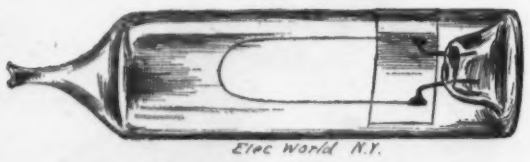
dence. Three of these, he said, contained carbon filaments and two of them contained platinum filaments. He showed these to prove that it takes an educated eye to tell which is which. It also takes an educated eye, he said, to determine which is which when they are illuminated, and yet some of the evidence upon which the defense relied was from those who could not have been experts or whose eyes were not educated, but yet who stated without hesitation that the filaments which they had seen were carbon and not platinum.

Mr. Seward concluded by claiming that lamps 1, 2 and 3 were so imperfectly constructed as to be incapable of use and reiterated the statement that there was nothing new in the present defense and that all the points raised had been previously adjudicated.

Mr. Fish summed up and closed for the complainants. He claimed that there was no precedent of one circuit court overruling another in another jurisdiction unless

Goebel Exhibit No. 9.

the proof of error in the first was absoluely certain, "clear enough to convict a man of a criminal offense," as one judge had expressed it. There was another law that when an invention had been given to the world and had proved a valuable one, the proof to defeat this by the allegation that the same thing had been done before must be of the clearest kind, and laid down a proposition that the proof must be absolutely certain. It had been claimed by the defendant that the plaintiff was derelict in that it had taken no steps to protect its patent prior to 1885, although the infringments previous to that date were frequent and flagrant. He denied that this was true, and stated that there had been no infringements except two instances that were unimportant. Edison's time had been wholly taken up previous to 1885 in perfecting systems of distribution, etc. Since that time the plaintiffs had pressed their suits with the utmost vigor. The defendant started his factory knowing that he was violating the law, but hoped that the patent would expire before the law was enforced. He had taken his chances and must stand the consequences. His capital was so small that he had nothing to lose, and the only redress for the plaintiff was an injunction. There were about 35 other manufacturers of lamps who went into the business for the same reason as the defendant. There are but two whom it has not yet been possible to proceed against in proper way. There are two now under restraining order besides the defendant. Mr. Fish stated that there are 80 licensees of the Edison patent in this country. These had paid for certain privileges, and the parent company was bound to protect them. If a restraining order were denied, the business of these 80 licensees would be destroyed and the licensor would be unable to keep faith with them. If an injunction were granted, the business of a small concern would be destroyed. If denied to this defendant, it could be denied to other defendants, and it meant the manufacture and sale of lamps not only in St. Louis, but in all parts of the country, by those who knowingly had infringed the patent and knowing the risk had decided to take it. He did not believe that the lamps 1, 2, 3, 4, 9 and 11 had existed prior to 1892. Had they been, why had this evidence not been used before? Some of these lamps had been in the hands of Mr. Bull in time to use in the Westinghouse (Sawyer-Man) case had he thought them worth using. He then stated that one affidavit in the Beacon



Goebel Exhibit No. 11.

case was sworn to a month or more before the suit was commenced, another the day after the papers were filed. It seemed that the testimony had been in process of manufacture before it was needed in order to have it in hand when it should be needed. The story had been growing, and thus we see that where one witness had testified to all that he knew, and it was found that more was required, the gap was filled in by that which was needed by testimony which was important, if true, and of a character which it would seem could not have escaped the witness' attention in his first statements, had they existed in fact.

THE EXHIBITS.

Exhibits marked Goebel Nos. 1, 2, 3 and 4 have already been described in the report in the Beacon case. Nos. 9 and 11 are new. No. 9 is very similar in almost all respects to No. 4 and has platinum leading-in wires, a carbon filament and a junction formed of stove polish in the coiled ends of the leading-in wires. The filament is now broken, but the lamp in question was burned for six weeks in the establishment of the Bigelow Manufacturing Company. Of these there were three.

The J. C. Goebel lamp No. 9 was found by J. C. Goebel, the son of Henry Goebel, a few days before Judge Colt's decision, in J. C. Goebel's house in Wallingford, Conn. It was one of three lamps given to him by his mother when he was expected to make a trip to Germany, which was previous to May 1, 1879. Two of these lamps he gave to George K. Clark about 1886 or '87. Lamp No. 9 was kept by him in a trunk until about the end of 1891. The trunk being required for use at that time the lamp was removed and found again about the middle of February in a bureau drawer. He claims that it has never been out of his possession since he first received it about June 1, 1878.

Dr. Wm. J. Mayer Lamp No. 11.—This was given to Dr. Mayer by Henry Goebel in 1885, who states that in that year he called upon Mr. Goebel at his store in Grand street, when he received this lamp from him, and states that this lamp has been continuously in his possession ever since. It will be noticed that this lamp has a different base from either 4 or 9, being re-entrant or concave instead of convex. The leading-in wires are platinum and the filament is of carbon. The tip or boss where the lamp was sealed off is now broken.

MR. GOEBEL'S TOOLS.

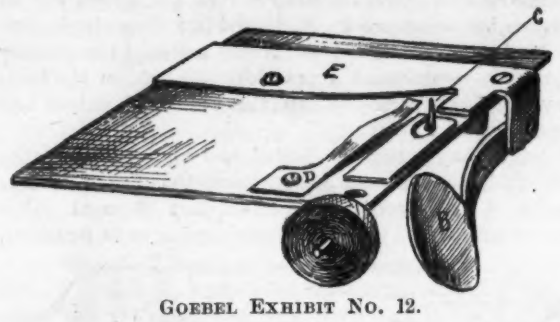
Of the exhibits marked Goebel Nos. 6, 7, 8, Goebel Reproduced Tool, and Goebel No. 12, the following is the history:

No. 6 was the first tool made by Henry Goebel to facilitate the shaving down of his bamboo strips previous to carbonization, and consists of a cast iron plate with a hinged top, A. This is held up from the base plate by two springs attached upon the plate A, and bearing on the base plate. By pressure, this descends upon the piece B to within a distance regulated by a stop in the plate A not shown in the cut. D is a roller, C a smooth steel plate, and B a cutting tool or knife similar to that employed in an ordinary plane. The bamboo strip, after having been reduced by hand to a convenient size, is placed upon the plate C, the lever A is depressed and the strip is drawn by hand between the roller D and C over the knife edge B, the operation being repeated until the strip is reduced to the diameter required. The stop referred to in A is for the purpose of preventing the roller D from descending into actual contact with the plate C, and, according as this stop is longer or shorter, the minimum diameter of the bamboo will be greater or less. Goebel claims to have made this in the early sixties.

Goebel No. 7 is another machine for the same purpose and of very similar design, and was made somewhat later than 6. The lever A is held up by two spiral springs instead of the kind employed in the other. The stop regulating the descent of A is here controllable, and consists of a screw terminating in a milled head B. The plate C and a knife D are essentially the same. In this the wheel which was noticed on the first instrument is wanting, the bearing surface being somewhat convex and to permit of easy introduction of the bamboo. Mr. Goebel says that he made four of these instruments prior to 1872, and that he sold three of them to Mr. Perkins in 1886; two of these, No. 7, just described, and No. 8, which is essentially the same in principle as No. 7, but is made of brass, were found and presented in evidence in the Beacon suit, No. 6 was also thus presented, but the fourth tool could not be found. Mr. Goebel was asked to reproduce this fourth tool to the best of his recollection. This reproduction is represented in the cut marked "Goebel Reproduced Tool." It is of brass. After this latter was made, a diligent search finally resulted in finding the original fourth tool, and this is presented in the cut marked "Goebel No. 12."

Rapid Transit in New York.

Rapid transit in New York through the Manhattan Railway Company has been decided upon by the Rapid Transit Commissioners, and it is probable that the former will eventually accept the terms offered, although at present they are protesting, as might have been expected, against them. The plan involves the following: First: A line from the Battery, along West and Barrow streets, to Bedford street, thence across Bedford, Commerce, Morton, Bleecker and Cornelia streets to the present Sixth avenue line at West Third street. Second: A line from the Ninth avenue line near 108th street, along 108th street, the Boulevard, Hamilton place and Tenth avenue to Fort George. Third: Within two years the present Ninth avenue road is required to be converted into a four-track railway between Barrow street and 108th street, with both express and way stations at Fourteenth, Forty-second and Fifty-ninth streets. Fourth: A third track on the Sixth avenue line is required between Eighth street and the junction of the new line at West Third street. Fifth: The foundations and structures of the lines provided for and the four-track line between Barrow and 108th street, as well as all parts of the present system that shall be reconstructed, shall be such as to permit the running of five-car trains at a speed of 35 miles an hour between stations. The foundations and structure of the new line shall admit of the construction of four tracks thereon and shall have three tracks to begin with, excepting the part between Battery place and Sixth avenue, and within three years of the completion of the branch line or extension to Fort George a branch line with not less than two tracks shall be built from 162d street, along the Kingsbridge road and Broadway, to the northern city limits. All the above improvements provided for south of Fort George shall be completed within two years after the acquisition of the consent of the property owners, and municipal authorities, for right of way. The company is given the option to lay and construct a fourth track from Greenwich street to Barrow street and Battery place, in addition to the fourth track hereby authorized and required on the Ninth avenue line. The franchise shall be subject to the right to construct and operate the underground road heretofore laid out by the commission, or that may be laid out hereafter, under the Boulevard. The Manhattan Railway Company is required to pay into the city treasury all the expenses of the commission since its organization and any that may be incurred by it in the



Goebel Exhibit No. 12.

future, and shall pay annually 5 per cent. of its net receipts, meaning thereby its gross receipts, less taxes and operating expenses.

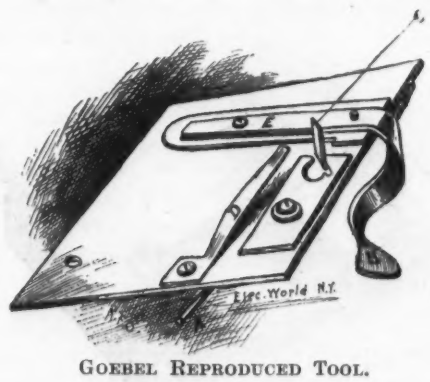
NEW BOOKS.

The Electric Railway in Theory and Practice. By O. T. Crosby and Dr. Louis Bell. Second edition, enlarged and revised. New York: The W. J. Johnston Company, Limited. 1893. 416 pages, 182 illustrations. Price $2 50.

As "Crosby & Bell" has passed into a recognized standard it would be superfluous at this day to review the points that have led to its wide popularity and acceptance as an authority, not only in the United States, but in Europe, where a French translation will soon appear. An unusually large first edition was exhausted in a very short time, and the authors improved the opportunity thus afforded to revise and considerably enlarge the matter for the second edition, just published. A great part of Chapter I. has been rewritten, and minor corrections and additions made throughout the book to bring the matter to date. Two appendices have been added, "Motors with Bevel Gear and Series-Multiple Control of Motors" and "Method of Measuring Insulation Resistance of Overhead Lines." Eight pages of accounting forms have been added to Appendix D, and the index has been carefully revised and considerably extended by additions from the index notes of a well known street railway engineer.

The Measurement of Electrical Currents, and Other Advanced Primers of Electricity. By Edwin J. Houston, A. M. New York: The W. J. Johnston Company, Limited. 1893. 429 pages, 169 illustrations. Price $1.00.

"Electrical Measurements, and Other Advanced Primers of Electricity" is the second volume of Prof. Houston's series of elementary electrical treatises for students and non-technical readers. A third volume will complete the



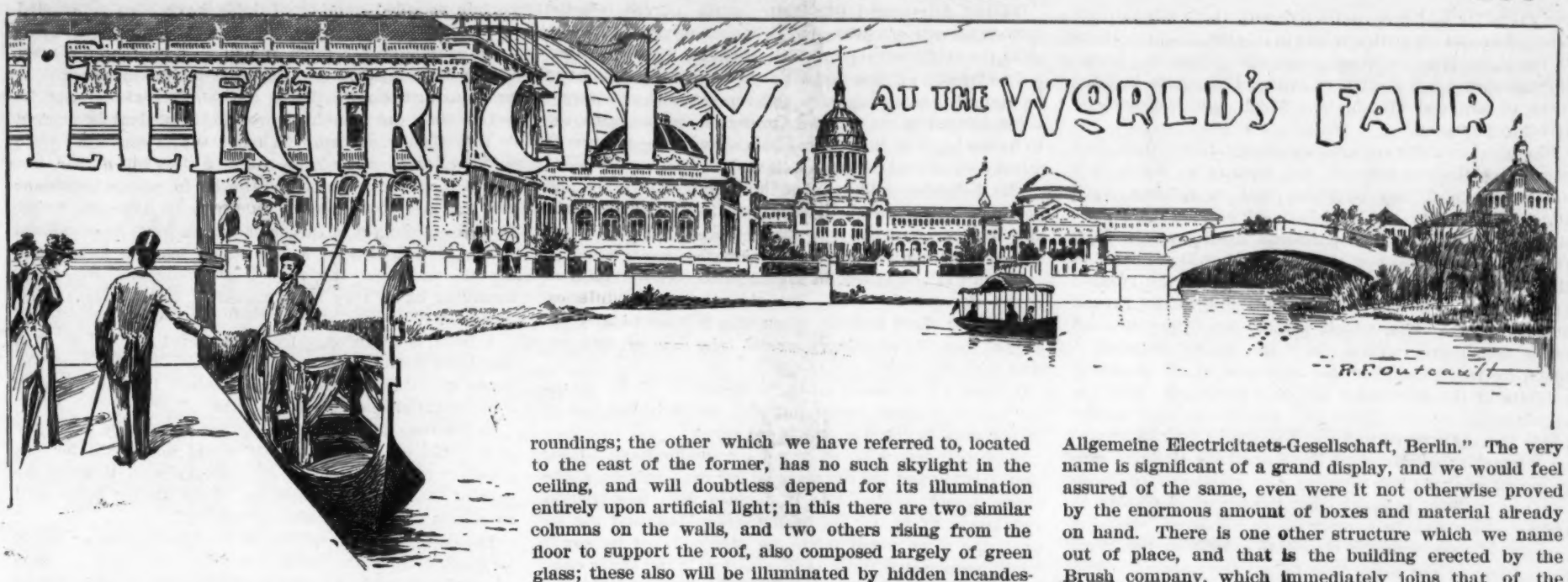
Goebel Reproduced Tool.

series, but there is no necessary connection between the several volumes, each one being complete in itself, as are the several primers in each volume, as far as possible.

The book derives its title from the first three primers, which are on the measurement of electric currents, electromotive forces and resistances, respectively. The object of these primers is not so much to teach the practical operations of electrical measurements as to explain in simple but exact terms the principles and apparatus upon which they are based.

Two primers are on voltaic and thermo-electric cells and other sources of electricity. The principles upon which commercial currents are based are explained in three primers, and nine others are devoted to the principles and applications of dynamos, motors and transformers, the eighteenth and last primer being a review or primer of primers.

The two hundred and odd pages on electric lighting and power deal very thoroughly with the different methods and apparatus in practical use. This section will be particularly welcomed by the large class of intelligent readers who desire to obtain a correct knowledge of the applications of electricity, and it will also, from the author's careful exposition of principles, be of marked value to electricians and students.



As the time approaches for the great exposition to open the interest in the state of the handsome exhibits of various kinds is rapidly increasing. With this issue of The Electrical World we commence a series of articles which while devoted chiefly to the exhibits in the Electricity Building will comprise all of those of an electrical nature throughout the exposition, and as these, at least many of them, will be spectacular in character, they will be accompanied by handsome illustrations made by our artist, so that the visitor to the Fair may obtain a good idea of the grandeur of the display before his arrival, or may refer to the pages of The Electrical World to call fresh to mind those displays which prove most attractive in the cursory or extended examination which he has been able to give them.

The visitor to the Electricity Building at the present time will undoubtedly be disappointed at the shape in which the exhibits are found. However, the little that is to be seen represents an immense amount of work, in fact the completed work of thousands of artisans from all parts of the world who have already laid down their tools, that have been used in the preparation of the greatest display of electrical apparatus and effects that has ever been made in the world's history.

Standing in the gallery at the north end of the hall and looking down toward the south entrance the first thing that catches the eye is the shaft and pagoda which is to form the base of the Edison lamp and the Phoenix Glass Company's exhibit, so handsomely illustrated in The Electrical World of April 8. At the present time this shaft is nearly complete and ready for the staff and wiring, and, in fact, a representative of the Edison Lamp Company is now in Chicago with the plans in hand ready to string the wires which are to carry current to this magnificent pile. It is only those who have watched the apparently frail wooden structures take shape into those of massive stone by the addition of the staff and other decorations who can realize the possibility in future for this now homely, plain wooden obelisk. But those who have seen the great white city arise as if in a night, from the swamps, have learned to appreciate that in the hands of the skilled artisan almost everything is possible, even within the limits of exceedingly restricted time.

The next structure to attract the eye, still further to the south, almost blocking the view of the central southern entrance, is the building erected by the American Bell Telephone Company for its exhibit; this is of the Corinthian style of architecture, and as far as the building itself is concerned it is apparently complete. Like most of the structures at the World's Fair this is of light frame work covered with staff, giving the appearance of the solidity and weight of massive stone. Within it is divided into a central interior court, surmounted by a dome; to the east and west run corridors, outlined by fluted columns and terminated at either end by small apartments, themselves with dome-like ceilings. At present no hint is given of the display to be given within, although it is to be supposed that in addition to the collection of telephone equipments it will be brilliant with incandescent lights. This building occupies floor space of about 70 by 90 feet at the extreme south end of the transept and extends between the main aisles, right and left, which terminate in the circle surrounding the display of the Phoenix Glass Works, before referred to.

Almost directly east of the telephone pavilion is the display of the Western Electric Company, which will include several structures, all of which are under way, and one of them nearly complete. This is a temple of decidedly Egyptian style of architecture, divided within into two principal rooms. One of these is open at the top with a square skylight, around the edges of which are already located and wired sockets for 40 incandescent lamps; around the wall are placed six fluted columns, composed largely of bottle green glass, behind which will be placed innumerable incandescent lamps, whose softened light passing through the dark green septum will be in keeping with the sombreness of the architectural surroundings; the other which we have referred to, located to the east of the former, has no such skylight in the ceiling, and will doubtless depend for its illumination entirely upon artificial light; in this there are two similar columns on the walls, and two others rising from the floor to support the roof, also composed largely of green glass; these also will be illuminated by hidden incandescent lamps. The other structures of this company have not taken sufficient shape to enable them to be described, but that it is intended to make a most creditable exhibit and to have it well in hand by the opening of the exposition is seen by the number of cases of goods as yet unopened, occupying floor space consigned to the company.

The display of the General Electric Company, which surrounds on all sides the central tower, is yet in confusion; an army of men, however, are at work and it will require but a few days to give a hint of the character of the structure which they will erect. Scattered here and there throughout the space which has been set apart for them are seen generators of all of the well known types of the various companies, which by their consolidation have given rise to this great concern, and we see here the handsome four-pole generators, such as are sent out to-day for the equipment of power stations—the older fashioned bi-polar machines, both of the Edison and T.-H. types; the Thomson-Houston alternating current machines and the familiar spherical armature arc generators; in addition to these there are some packed goods on the floor, but most of those which have arrived at the date of writing have been removed from their cases, although not permanently installed.

The Thomson Electric Welding Company has already in position one four-pole generator, type 15 C. C.; one large six-pole generator and transformer and other machinery peculiar to the electric welding process. Nearby, and to the west is the space of the Johnston Conduit Company, which is already well filled with an exhibit of the well known metallic conduit and accessories, junction boxes and manways. Directly adjoining these are quite a number of cases of L. J. Wing & Co., 126 Liberty street, New York, containing their specialty fans. None of these have been unboxed as yet. The Standard Electric Company, which is located in the immediate vicinity, has a number of its generators on the floor, but not permanently set.

The French exhibit, which is located in the space directly north of the General Electric Company, and extends over in a northwesterly direction into the large bay, at the northwest corner of the building, gives promise only in the shape of a large number of packing cases; but few of these have been opened. What strikes the visitor as strange, however, for an exhibit in the electrical building, is that a large number of these cases are marked "Musical Instruments," and a considerable proportion of them pianos and organs, and the shapes of the cases themselves bear out the accuracy of the label. Since it is believed that nothing will be admitted to this building that is not of an electrical nature, one's curiosity is aroused as to how electricity is to play its part in these familiar instruments. Many of the cases are marked, "Telegrafie," which would indicate a large display of instruments devoted to electrical communication between points at a distance; some of these have been unpacked and show types of instruments with which we are little familiar in this country.

Messrs. Queen & Company have space at the north end of the hall, and on this quite a force of men are now at work; the raised platform on which their exhibit will be made is 25 × 75 feet, running easterly and westerly, at the eastern end of which a simple edifice has been erected, and it is understood is intended to serve as a dark room for the exhibition of such phenomena as require such surroundings.

Directly east of the French exhibit and also adjoining Queen & Company's is a portion of the German exhibit; here is found the largest pile of packing cases to be seen on the ground floor, all of which are designated by a label bearing the German flag, the names of the consignee and the consignor and some titles significant of the character of the contents. A single structure within this space is already under way, and on the north face of this we find, outlined in incandescent lamp sockets, the name of the well known German concern, "The Allgemeine Electricitaets-Gesellschaft, Berlin." The very name is significant of a grand display, and we would feel assured of the same, even were it not otherwise proved by the enormous amount of boxes and material already on hand. There is one other structure which we name out of place, and that is the building erected by the Brush company, which immediately joins that of the American Bell Telephone Company. This is near the southwest corner of the ground floor, and is 24 feet square. While the ground plan of the building proper is that of a square, the interior, which is reached through doors at the centre of each if its sides, is circular and is surmounted by a dome; there are no skylights or windows, and in the present state of its completion it is impossible to guess to what specific use it will be placed.

The Brush company have promised a surprise to their friends, and we must wait contentedly until a later day to find out the character of that they have in store.

Other exhibits already on this floor may be mentioned. A large hoist, bearing imprint of the Lidgerwood Manufacturing Company, of 96 Liberty street, New York, and a small electric mining locomotive, both on or adjoining the space assigned to the General Electric Company. The E. S. Greeley & Co., of New York, are represented by a most generous stack of unopened packing cases. The Electric Forging Company have quite a number of machines, adapted to their specialty, already on hand, some of which have been unpacked, but none of which have been permanently installed at the time of writing. The phonograph is also to be conspicuously present, as evidenced by nearly a hundred nickel-in-the-slot phonograph cases now stacked at the south end of the hall east of the entrance.

Both at the north and south end of the halls there has been erected for temporary use a small electric elevator, furnished by the Eaton & Prince Company, operated by Eddy motors; these are employed in raising to the gallery floors the material which is there to be displayed.

Ascending to the galleries we find the two bays, which have been set apart for cafes, still untouched; the tables, however, have arrived and are lying upon the ground floor near the north elevator. There is not much to be seen in either of the galleries thus far, but our readers will be interested to know that here in the northwest gallery, facing on the open well, near its south end, and to the east of it, will be located the headquarters of The Electrical World, whose doors will be open to them at all times during the existence of the World's Fair. In the same gallery and near at hand overlooking the floor beneath are the spaces assigned to Austria and Spain; south of the well and east of the stairway will be the display of New South Wales, and diagonally across the way from The Electrical World's headquarters will be the exhibit of that remarkable little kingdom, Monaco. The northeast gallery will be occupied entirely by the remainder of the German exhibit, a portion of which we have referred to before. Nothing has been unpacked or erected here as yet, but, as in the space on the ground floor assigned to this country, the promise is most flattering, as the floor is almost entirely covered with large packing cases, sometimes two and three cases being packed one upon the other.

The southeast gallery as well as the southwest has been largely assigned to smaller exhibits which will be described in a later issue; there is one, however, that is certainly deserving of attention at the present time in the southeast gallery, namely, that of the Chicago Electric Wire Company, which has the distinction of being the first exhibit to be completed, for it is now practically completed. The space has been fenced off by a handsome black walnut railing, the posts of which are neatly wound with their well known insulated wire; within the railing there are nine pyramids, consisting of coils of their various sizes of insulated wire, which also have a very pleasing and tasteful appearance.

But when we are speaking of insulated wires, we always have in mind Day's Kerite, for, as electricians know, it is apt to be foremost in every fight, and we are not disappointed in this case, for not far behind, in point of completion, though still incomplete, is Mr. W. R. Brixey's pavilion, which is handsomely finished in its interior in buttonwood. This occupies a floor space of 9 × 9 feet, the ceiling being supported in the centre by a

central pillar which is connected with the walls by four tasteful arches, in lattice work; in this building, too, there is no light from without except that which creeps through two small ventilators in the ceiling; this is indicative of artificial illumination which will doubtless be given in profusion.

Electrical exhibits are arriving almost faster than they can be handled; to estimate the rapidity at which they are coming in, it may be stated that on Monday, April 10, there were in the neighborhood of 300 cars consigned to the electrical department awaiting unloading. It is significant, however, that the goods which have had the farthest to come are the first to be on the ground; in quantity, particularly, is this noticable in the French and German exhibits, which, judging from the unpacked cases which everywhere strew the spaces assigned to them, by far outnumber the aggregate of all the other exhibits in the Electricity Building combined. The disappointment of the visitor at the meagreness of the goods already arrived and the apparently unfinished and unsatisfactory condition of the Electricity Building will be much allayed, however, by the statement of those who are qualified to speak, that the electrical display at Chicago is to-day in a much more advanced state of completion than was the electrical exhibit at the Paris Exposition at the same time before the opening. The officials who have most closely at heart the success of the enterprise, and who know most about it, speak hopefully of the opening day, and express themselves as confident that although the exhibit will not be entirely complete on the 1st of May, it will be in a very creditable condition for the inaugural ceremonies.

On Monday, April 10, the authorities and friends of the Exposition were filled with dismay at the strike of the mechanics of all kinds employed in and around the Exposition buildings, and which extended to every department; for by the withdrawal of these men at this time there seemed little hope of a successful opening at the time appointed. The strike, however, was as short lived as it was unreasonable, and was condemned on every side by the press, and, it is reported, by a majority of the men also who were forced by the authority of the leaders to withdraw. At a meeting Monday evening, however, the strike was declared over, and on Tuesday morning the men who had walked out the day before returned to their posts and it is believed now that no further embarrassment need be feared in this direction.

The Design of a Central Station for Incandescent Electric Lights.—III.

BY E. P. ROBERTS.

The previous sections of this article* gave some arguments as to why it is advisable to pay whatever sum is necessary in order to obtain good advice, not only as to the mechanical design of an electric light station, but also as to the preliminary investigation upon which the design is based, and as to the operation after erection. It is not probable that a station designed on an incorrect analysis of the situation, or not designed correctly when the conditions are known, or not efficiently operated, will prove the most economical station which could have been erected.

The writer then takes up the design of a station for a town of 10,000 inhabitants, gives the number of each class of customer probably obtainable, calculates lamp output tables for the same, and shows the result graphically by means of curves, and then adds together all the tables or curves, to produce the lamp output diagram for the station.

* See The Electrical World of March 4 and 25, 1893.

Having determined the lamp output curves for the various classes of customers, it is next advisable to consider the relative value of their custom. This is particularly advisable, if it is desired to operate a small plant at its highest earning capacity, and especially so if contract rates, instead of the generally preferable meter rates, are to be the basis of charge, and also when the plan, usually a bad one, of free wiring is followed.

The following table shows the income per lamp and per horse-power installed, and the calculations are made as follows:

Columns I. and II. need no explanation.

Column III. is based on probable number of lamps at times of maximum load. Probably there will be times, usually for short periods, when this will be slightly exceeded, but the machinery should take care of such excess without injury.

Column IV. is based on the supposition of 10 lamps per indicated horse power and with an additional loss of 15 per cent. in the line and house wires.

If 60-watt lamps be used and the engine have 10 per cent. friction and the dynamos 90 per cent. efficiency, the above would result. Also if engines with less friction and lamps of higher initial efficiency but shafting be used, the same result might be obtained (of course it might happen that the I. H. P. cost less in the latter case, but that is not the point at issue). Undoubtedly the figure will be considered high by many, but it is much easier, for any one studying the table, if the factor of 10 be used, because, for those not agreeing, it only requires a mental effort to add the desired percentage.

Columns V. and VI. are self-explanatory. "S" stands for summer and "W" for winter.

Column VII. shows the total number of hours of use in summer and in winter, and what percentage this number is of the total possible number of hours, as given in column V.

Most of the items need no special explanation, but for some it may be advisable. The theatre is considered as being used nine times a month; churches the same.

Column VIII.—The income is considered as one cent per lamp hour, corresponding, if 60-watt lamps be used, to $24 per kilowatt hour, and, for 50-watt lamps, to $20 per kilowatt hour; possibly ¾ cent per lamp hour would be a better average figure, but one cent is often obtained, and generally should be, and is used for the same reasons as advanced for considering 10 lamps per I. H. P.

The amount received per horse power installed being given and also the percentage of total lights in use by any class of customer, or of any special case, at the time of maximum output, then the relative desirability of such customer can be perceived. When the expense of operating is obtained, still further light can be thrown upon this investigation, as the expenses are divided into two classes, fixed and variable.

At this point, however, it is clear that, the greater the length of time each light operates, the more the profit, because the fixed charges per lamp installed are the greater part of the expense account, from 65 per cent. to 80 per cent., and the variables—coal, oils, etc.—not being more than from 20 per cent. to 35 per cent. Therefore the investigation of the above tables will indicate very clearly what custom should be obtained at the start, in order to place the station on the best paying basis. The methods followed to obtain such special customers as are desired are various. One often followed is to place wire and plain fixtures in place, without charge, for all desiring light to be used on an average not less than a specified number of hours per day, and offering less inducement to customers using lights a shorter time, the offer holding good either to a certain date or until a certain specified number of lights have been contracted for.

By examining the table, it will be seen that the most showy installations are not necessarily the best. A previous article showed that the third-class hotel may be better than the first-class, provided the plant is worked to its capacity. It may be true that in one case more may be obtained per lamp installed than in another, but in the latter case less investment in power, dynamos and line may be necessary. If wiring be done at a profit, the latter contract is the one to work for. As a general thing, installations of a few lights burning long hours are the best, but the very best customers are those installing lights very seldom used at times of maximum output.

A bank is often considered poor custom, and so it is per light installed, but the lights are seldom used at times of maximum load, and therefore it helps to make a rectangle of the output diagram.

In the case considered, the factory would be good pay if it could be assured that it would never call for full capacity after 6:30 to 7 p. m., especially so because the cost of the line wire would be, if the station be located as shown in the plan, almost nothing.

The case of the pressroom of the morning paper would be good, because the lights would be used after the time of maximum load. Careful search should be made for all such custom, and it should be obtained whenever possible.

The annual income per lamp is $8.40. In large cities this may be increased to $10, but in towns where early closing is the rule, or which are chiefly maintained by an agricultural community, or where gas can be very cheaply produced, it may fall to $6 or even less. Each plant must be considered by itself, but whatever may be the local conditions careful analysis pays.

I.	II.	III.	IV.	V.	VI.						VII.				VIII.			IX.			X.		
	Lamps.				Daily load.						Lamp hours per month.				Income per month								
					5 days each		Increase on Saturday.		Sunday.						Total.			Per lamp installed			Per horse power installed.		
Class.	Installed.	On at time of greatest load.	Horse power installed 15 per cent. line loss.	Possible number of lamp hours per month of 30 days.	S.	W.	S.	W.	S	W.	S.	Per cent.	W.	Per cent.	S.	W.	Average.	S.	W.	Av'r-age.	S.	W.	Average.
Groceries	60	50	5 75	43,200	178	258	50	50	48	52	5,020	12	7,116	16	$50.20	$71 16	$60.68	0.84	1.19	1.02	$8.73	$12 38	$10.56
Meat markets	30	25	2 88	21,600	89	129	25	25	24	28	2,513	12	3,566	17	25.13	35.66	30.40	0.84	1 19	1.02	8.73	12 38	10.56
Bakeries	40	35	4.03	28,800	160	200	35	35	60	70	4,540	16	5,620	20	45.40	56.20	50.80	1.14	1.41	1.28	11.35	14.05	12.70
Stationers	20	18	2.07	14,400	56	73	15	15	12	14	1,664	12	2,014	14	16.64	20.14	18.39	0.83	1.00	0.92	8 32	10.02	9.17
Dry goods	150	125	14 38	108,000	376	481	125	125	36	42	10,420	10	13,574	12	104.20	135.74	119.97	0.69	0.80	0.75	7.23	9.42	8.33
Clothing	60	50	5 75	43,200	141	194	50	50	24	28	3,962	9	5,356	12	39.62	53.56	46.59	0.66	0.90	0.78	6.88	9.31	8.10
Jewelry	40	35	4.03	28,800	134	167	30	30	24	28	3.700	13	4,574	16	37.00	45.74	41.37	0.93	1.14	1.04	9.25	11.43	10.34
Furniture and hardware	30	20	2.30	21,600	49	70	15	15	12	14	1,382	6	1,936	9	13.82	19.36	16.59	0.46	0.65	0.56	6.01	8.42	7.22
Restaurants	30	30	3.45	21,600	115	145	.. ...	.....	115	145	3,450	16	4,350	20	34.50	43.50	39.00	1.15	1.44	1.30	10.00	12.61	11.30
Bank	10	3	0.35	7,200	24	29	.....	.....	24	20	720	10	866	12	7.20	8.66	7.93	0.72	0.87	0.79	20.57	24.75	22.66
Drug stores	60	50	5.75	43,200	240	288	.....	.....	240	288	7,200	17	8,640	20	72.00	86.40	79.20	1.20	1.44	1.32	12.52	15.03	13.78
Cigar stores	40	30	3.45	28,800	152	182	.....	.....	24	28	4,048	14	4,844	17	40.48	48.44	44.46	1.01	1.21	1.11	11.73	14.04	12.89
Saloons	115	100	11.50	82.800	775	900	.....	.....	775	900	23,250	28	27,000	32	232.50	270.00	251.23	2.02	2.35	2.19	20.21	23.48	21.80
Factories	100	100	10.00	72,000	65	175	.....	.....	60	70	1,930	3	4,830	7	19.30	48.3	33.80	0.19	0.48	0.33	1.93	4.83	3.38
Lumber yard	10	5	0.58	7.200	12	18	.....	.....	12	18	360	5	540	8	3.60	5.40	4.50	0.36	0.54	0.45	6.21	9.31	7.76
Tailors	50	30	3.45	36,000	103	129	30	30	12	14	2,846	8	3,530	10	28.46	35.30	31.88	0.57	0.71	0.64	8.25	10.23	9.24
Printers	25	20	2.30	18,000	69	89	.....	.....	69	89	2,070	10	2,670	15	20.70	26.70	23.70	0.83	1.07	0.95	9.00	11.61	10.30
Wholesale	50	30	3.45	36,000	33	68	.....	... ..	24	28	954	3	1,880	5	9.54	18.80	14.17	0.19	0.38	0.29	2.77	5.44	4.10
Offices	60	40	4.60	43,200	73	116	.....	.....	63	76	2,150	5	3,320	8	21.50	33.20	27.35	0.36	0.55	0.46	4.67	7.22	5.94
Residences	1,035	275	31.65	745,200	1,375	1,700	.....	.....	1,375	1,700	41,250	6	51,000	7	412.50	510.00	461.25	0.40	0.49	0.45	13.05	16.17	14.61
Depot	20	15	1.73	14,400	110	135	.....	.....	110	135	3,300	23	4,050	28	33.00	40.50	36.75	1.65	2.03	1.84	19.65	23.41	21.53
Lodge hall	40	40	4.60	28,800	135	135	.....	.....	.....	.....	1,755	6	1,755	6	17.55	17.55	17.55	0.44	0.44	0.44	3 82	3.82	3.82
Court house and jail	40	20	2.30	28,800	48	72	.....	... ..	48	52	1,440	5	2,080	7	14.40	20.80	17.60	0.36	0 50	0.43	6.26	9.04	7.65
Post office	20	20	2.30	14,400	40	62	.....	.....	24	28	1,136	8	1,724	12	11.36	17.24	14.30	0.57	0.86	0.72	4.94	7.49	6.22
Engine houses	35	15	1.73	25,200	64	71	.....	.....	64	71	1,920	8	2,130	9	19.20	21.30	20.25	0.55	0.61	0.58	11.10	12.31	11.71
Churches	65	50	5.75	46,800	135	135	.....	.....	135	135	1,215	3	1,215	3	12.15	12.15	12.15	0 19	0.19	0.19	2.11	2.11	2.11
Hotels	825	513	59.00	594,000	2,038	3,666	....	.....	2,038	3,666	61,140	10	91,980	15	611.40	919.80	765.60	0.74	1.11	0.93	10.36	15.58	12.97
Theatre	300	250	28.75	216,000	.....	865	.....	.....	.....	.....	.....	.....	7,785	4	.....	77.85	38.93	0.00	0.26	0.13	.....	2.71	1 35
Total	3,360	1,760	192.40	2,404,800	6,789	9,952	375	375	5,452	7,147	195,335	8	269,925	11	$1,953.35	$2,699.25	$2,326.41	0.58	80½	0.70	$10.15	$14.03	$12.09

The Standardizing of Electrical Instruments.—II.

BY W. M. HILL.

Instead of the boxes R_1 and R_2, a rheostat may be used as shown in Fig. 6; but this instrument must be adjusted within 1-25 of one per cent. and checked occasionally, in case there has been any change in the coils. This rheostat was devised by Edward Weston, and renders the use of the bridge unnecessary. It consists of about four sets of plates arranged in a circle as A B C and D. E E is an arm, making contact with the plates by means of springs at each end, and turning upon an axle, H, at the centre of the plates.

The circles are divided along the line e, f, g, etc., and stops for the arms are placed at these points. As the arm is turned and resistance is taken from the upper side of the circle, the lower half of the arm puts resistance into the lower side.

Resistance coils are attached, underneath the plates, of 1,000 ohms in D, 100 ohms in C, 10 ohms in B, and one ohm in A. The upper halves of these circles are connected up as R_2 and the lower as R_1.

A case, with a slot coinciding with the scale, must be constructed to fit over the standard, so that lines may be drawn without disturbance by currents of air; for the pointer is very light, and easily deflected.

Voltmeters of all descriptions may be now connected in parallel, and checked off by this standard.

It has been observed that among certain practical men an impression exists that voltmeters may be checked in series. This can only be done when each instrument has exactly the same resistance; for, take the line a b, representing a wire carrying a constant current; take points at c, d, e, and f, and c d and e f may represent the resistance of two voltmeters; it will be seen

that the E. M. F. between c and d is not equal to that between e and f.

Now suppose c d and e f to be in parallel, then the E. M. F. between c and d will be equal to that between e and f.

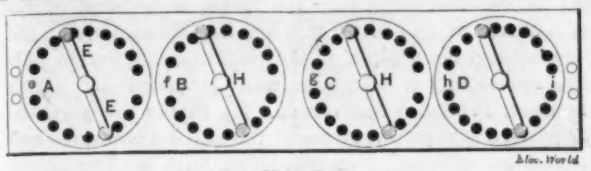


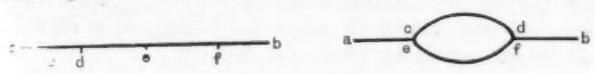
FIG. 6.

In order to make a more rapid, fine adjustment of the pointer to a mark, it is customary to use a second rheostat in connection with the standard; this is called a drum rheostat, and is shown in Fig. 9, as devised by Mr. Weston. It consists of a short, light cylinder of wood, A, around which a fine German silver wire is wound in a helix; through the axis (c) of the cylinder is a screw of the same pitch as the wire helix and fastened to this screw is the arm c c, turning down the side of the cylinder and connecting with the wire by a spring f. This arm is turned by the handle d. Connection is made with the two ends of the wire by the binding posts, e and e, and with the arm by the binding post, g.

The two rheostats are connected as shown in Fig. 7. M is the standard, R_1 the large rheostat, R_2 the drum rheostat, K the instrument to be tested, and B the current generator. The needle is brought near to the mark by adjusting on R_1, and the fine adjustment is made on R_2.

A CONVENIENT AMMETER STANDARD.

For an ammeter standard it is best to use a Weston millivoltmeter, which may be obtained of the same form and size as the laboratory standard voltmeter with a long point, and scale; the resistance of this instrument should be from about six to twelve ohms, and the movable coil is wound with German silver wire for the purpose of reducing any error which may arise from changes of temperature. The instrument is provided with a Ger-



FIGS. 7 AND 8.

man silver shunt, which is accurately adjusted to the resistance required for the pointer to be at the right place on the scale when the current to be measured is passing through the standard; this shunt is placed in a box filled with some non-conducting oil, for the purpose of insulation, and to prevent sudden changes of temperature.

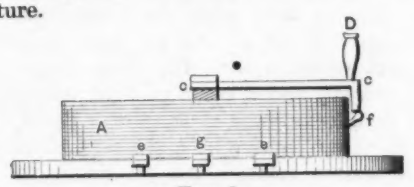


FIG. 9.

The box is provided with binding posts convenient for connecting the millivoltmeter, as shown in Fig. 11.

To find the proper resistance for the shunt, first find the current, which, in passing through the millivoltmeter alone, will raise the pointer to the required place at the top of the scale; next, measure the resistance of the instrument with the leads which connect it to the shunt upon the bridge to about the third or fourth place of decimals; and last, calculate the resistance of the shunt by the formula,

$$s = \frac{G\,g}{A - G},$$

where s is the resistance of the shunt, G the current which passes through the millivoltmeter, and g the resistance of the millivoltmeter.

To find the current which is to pass through the millivoltmeter, connect up a resistance box in series with the millivoltmeter, so that both are in parallel with the voltmeter standard and bring the pointer of the standard up to the 10 volt mark; now, keeping the pointer upon this mark, adjust by the resistance box until the pointer of the millivoltmeter comes to the required mark on the scale; then disconnect from the standard and measure the resistance of the box with the

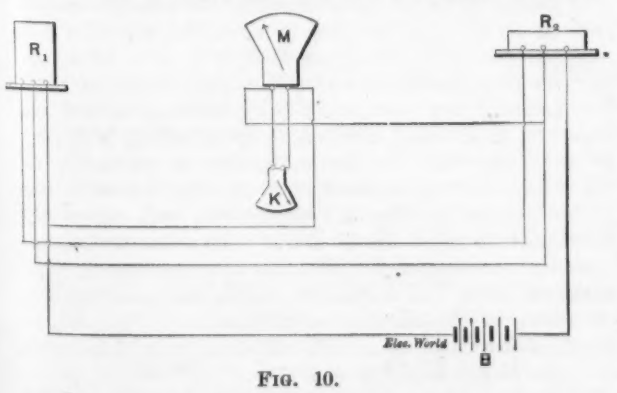


FIG. 10.

millivoltmeter and all the connections. Le this be R; then $c = \frac{R}{10}$ where c is the current in amperes.

To adjust German silver shunt, first adjust by the bridge as nearly as possible; then connect up after the comparison of potential method shown in Fig. 12, where a b is a standard resistance, which may conveniently be .01 ohm, consisting of ten .1 ohm standard coils in parallel; A B is the shunt, having binding posts at c and d, where the millivoltmeter is connected; C is a battery with a reversing key; S is a switchboard; and G, a high resistance galvanometer, provided with a scale, telescope and key K_1.

Connect the plates g_1 with w_1 and g_2 with w_2; press the key K_1, note the deflection on G, and call this D_1; take out the plugs and connect g_1 with b_1, and g_2 with b ; press K_1, note the deflection on G and call it D_2, then

$$\frac{D_1}{D_2} = \frac{\text{Resistance e f}}{\text{Resistance c d}}.$$

The binding posts c and d may be soldered at different places until the correct, or very nearly correct, resistance is obtained.

After adjusting thus far, set the shunt into the box, and measure the resistance very carefully by the fall of the potential method, shown in Fig. 13. The apparatus is the same as before, except a low resistance galvanometer G, and a graduated wire, H O, which may,

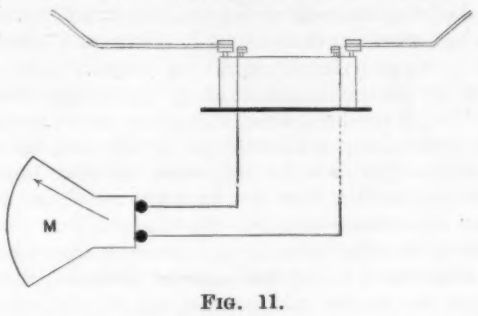


FIG. 11.

be taken from a slide bridge. The switch and high resistance galvanometer are not used.

Connect one wire of the galvanometer to binding post c, and the other to slide t; move the slide along the graduated wire until a point l, is reached at which there is no deflection on the galvanometer when K_1 is pressed; connect the first wire at d, e and f successively, and obtain points n, p, and g where there is no deflection; then

$$\frac{\text{Resistance c d}}{\text{Resistance e f}} = \frac{\text{Resistance l n}}{\text{Resistance p g}}$$

The resistance c d is calculated and carefully preserved.

Care should be taken in this test to close the battery circuit only when necessary, in order to prevent temperature error.

The following are some shunt resistances for given ranges of amperes:

Ampere ranges.	Resistance of shunt.
100	.00587
50	.00587
25	.0111259
15	.0186247
5	.055235
1.5	.3
.300	2.887

The copper voltameter may be preferred by some for adjusting these standards on account of the directness of this method; but although the voltameter eliminates all the slight errors which may be made in measuring resistances, etc., it must be remembered that the E. M. F. of the Clark cell has been very carefully determined by experiments, extending through years, while all possible

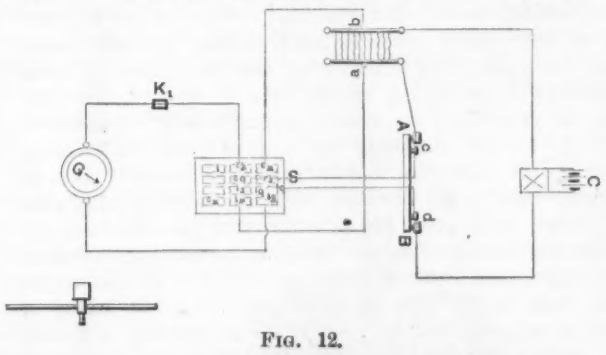


FIG. 12.

precautions were observed; and the copper voltameter cannot be extremely exact, even in most skillful hands.

A convenient form for a copper voltameter for large currents is shown in Fig. 14.

B is a wooden frame which fits over a glass jar and carries two copper strips, one for the positive and the other for the negative plates; each strip has a binding post (l and m) for connection with the main current. Upon these strips are the binding posts, a, a, a, etc., which fasten in the negative plates, c, c, c, etc., and b, b, b, etc., which fasten in the positive plates, c, c, c, etc.; each plate carries terminals to fit into the binding posts.

Before using these plates are dipped into a bath of nitric acid, with about 1-100 part hydrochloric, and then dipped into hydrant water, and last into distilled water; then they are carefully dried in clean filter paper, allowing as little exposure to the atmosphere as possible. Should any oxidized spots appear, they should go through the baths again. Then they are weighed after setting up the voltameter in series with the standard, and allowing a known current to pass for about an hour, the positive plates are taken out, put through baths of hydrant and distilled water, carefully dried and allowed to stand for some time in a case with cloride of potash or some other drying substance, until all moisture disappears, after which they are again carefully weighed.

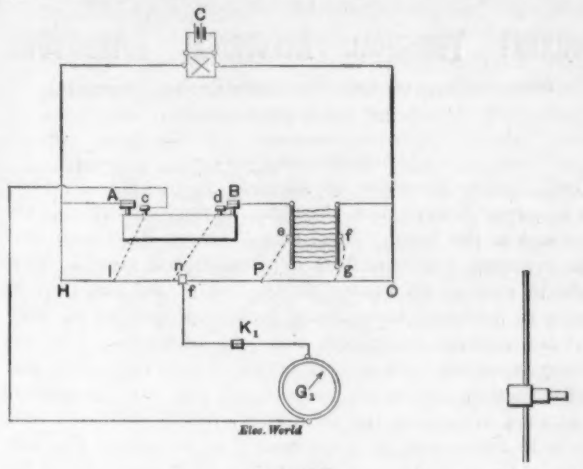


FIG. 13.

One ampere deposits .000326 grammes of copper per second.

After the top mark has been carefully fixed upon the millivoltmeter, it is calibrated by connecting a resistance box in series with the instrument, so that both shall be in parallel with the voltmeter standard and adjusting by the resistance box, until the pointer of the millivoltmeter comes exactly upon the top mark for about ten volts; then lines are drawn directly from the voltmeter standard.

To check off this standard at any time, connect up as above, and adjust to the mark to be tested; disconnect and measure the resistance of the millivoltmeter together with the box and connections, also the resistance of the millivoltmeter alone with its connections which are used on the shunt.

Let the resistance for ten volts be G, the resistance of the instrument and connections be R, the current going through the millivoltmeter be a, and the current which the mark represents be A.

$\frac{10}{G} = a$ and $A - a = c$;

where c is the current which goes through the shunt.

$$c \times s = E;$$

where E is the E. M. F. between the small binding posts of the shunt, when the current A is passing through the standard, and S is the resistance of the shunt.

$$10 : C :: E_1 : R;$$

where E_1 is the E. M. F. between the ends of the millivoltmeter connections, when current A is passing through the standard. If E be equal to E_1, the mark is absolutely correct.

Ammeters are manifestly calibrated and tested in series with this standard.

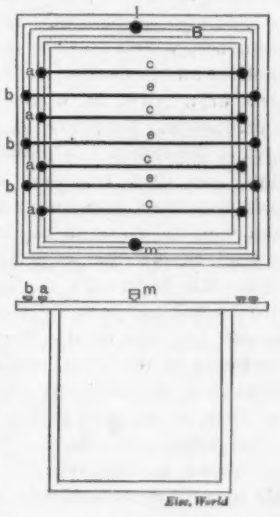


FIG. 14.

The current used for this standard may be taken from storage batteries, or from a constant current dynamo; it must be regulated by a rheostat, which will not burn out, and still be capable of very fine adjustment.

A good form of rheostat for this purpose is shown in Fig. 15. A B C D is a stand with a screw of small pitch running through the board, D; the inside end of this screw is connected with the wooden block H, which slides along as the wheel E is turned; the space between blocks H and O is filled with plates, three or four carbon to one of copper in alternation, which slide between two rods, such as e; these rods are removable, and held by thumb screws a, a; the copper plates are joined by cables to binding posts f, f, f, etc., and the binding posts are joined to two copper plates on each side, to which the two poles of the main circuit are connected. The resistance may be considerably altered by disconnecting the cables.

For fine adjustment a second screw carrying a wheel

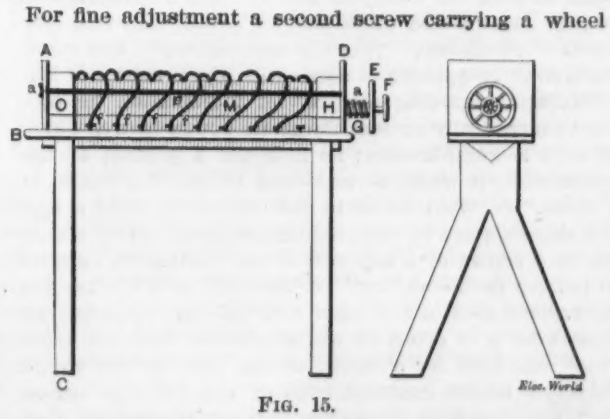


FIG. 15.

F turns inside the screw G; this small screw is fastened to block H, making the fastening for G. As the wheels are turned the plates M are compressed, thus diminishing the resistance in the circuit.

THE ELECTRICAL WORLD'S DIGEST

OF

CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Differential Equation of Electric Flow.—Mr. Blakesly in a paper before the Physical Society (London), abstracted in the Lond. "Elec. Eng.," March 31, states that the ordinary mathematical expression for electric flow fails to explain all known facts, and points out that in order to interpret these facts certain properties of matter not usually recognized must be admitted. The ordinary equation for a simple circuit having resistance and self-induction takes no account of any energy except that used in heating the conductor; where radiation into space is concerned, it is necessary to introduce another term, k C, in which k is a quantity of the nature of resistance, and C the current. He shows that a magnetic field induced in phase with the magnetic induction would not result in a loss of energy, and no hysteresis could exist; under the same circumstances there could be no radiation of energy from an alternating magnet. To allow for radiated energy, R must be virtually increased to R+k, and the total energy is divided between the circuit and the field in the ratio of R to k; if k is large as compared with R, say by having high frequency, the heating of the circuit may only be a small part of the total energy. He thinks the true explanation of some of Tesla's experiments is that energy is expended chiefly in radiation and not in current passing through the experimenter's body. Prof. Lodge thinks the best definition of R is that derived from Joule's rather than from Ohm's law; he thinks that in Tesla's experiments there was not enough energy in the apparatus to do any serious harm. Mr. Swinburne thinks that there is a tendency to overestimate the rate of high frequency currents, for unless the coils of transformers were assumed geometrically coincident, calculations were difficult, as errors of hundreds per cent. were quite possible.

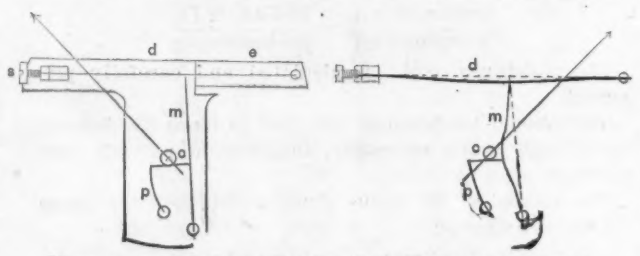
Skin Deep Conduction.—Referring to Mr. Swinton's experiments, which tend to show that with very high frequencies an alternating current flows only in the external parts of a wire, M. d'Arsonval thinks the explanation is erroneous. To prove it, he passed a high frequency current through a fine platinum wire immersed in petroleum, and then repeated the experiment with a continuous current, and found that the heating of the petroleum was the same in the two cases. The Lond. "Electrician" thinks this experiment quite illusory. According to Mr. Swinton's explanation only the skin of the wire is taking part in conveying the high frequency current, and the $C^2 R$ effect depends not on the ohmic resistance of the wire, but on the resistance of a cylindrical shell of unknown thickness, the interior core taking little or no part in the action.

Electricity.—Mr. S. F. Walker continues his serial on "What is Electricity?" in the Lond. "Elec. Eng." The present section is devoted to generation by chemical action. It forms interesting reading but contains nothing particularly new, and does not admit of being abstracted.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Congress Proposals.—The March number of the bulletin of the "Soc. Int. des Elec." contains the official report of the discussion, before that society, of the American proposals for the adoptions at the Congress. Mr. Guillaume's remarks were published in full in these pages in last week's issue, p. 283, those of Mr. Blondel were abstracted in last week's Digest, and his suggestions for a secondary standard of light, in the form of an arc lamp, are abstracted below. Mr. Hospitalier's remarks were as follows: He states that the term "absolute" units is not correct, as there are a number of such systems of units; the term "C. G. S." should be used instead, as that is the particular system referred to; he thinks there is no need to adopt a practical unit for magnetomotive force equal to 1-10 of the C. G. S. unit; as calculations are not simplified thereby, the factor 4π does not disappear and the transformation into ampere turns would often lead to errors; regarding the terms "reluctance," "electric conductivity" and "conductance," he appears to agree with the remarks of Mr. Guillaume; regarding the unit of illumination he protests energetically against the name bougie-metre, which he says is quite inexact; as it is not a product of the two factors, it would be necessary to say, "a candle at a metre," or, what would be still better, to adopt a special name defined by the illumination produced by a candle on a screen at a distance of one metre; he appears to indorse the name "lux" for this unit, which term has never been used in any other way (in this, however, we believe he is in error, as we understand that the name "lux" was used for a candle at one foot; its use would therefore create confusion, and it was for this reason that the American committee did not recommend that name); he approves very highly of the suggestions to oppose all changes of practical units already universally adopted; he presents no objection to the names gilbert, weber and gauss, but does not approve of their values; the unit for magnetic field, for instance, is such that it will always be necessary to use very small fractions of it, as a field of 13,000 C. G. S. units, for instance, would be written .00013 gauss, while the earth's field would be .000000004 gauss (he does not, however, suggest any better set of values). He approves of the suggestion not to adopt a new name for ampere-hour and kilowatt-hour, also of the proposition to oppose adopting a universal wire gauge, as the only logical solution of that problem is the radical suppression of all gauges. He finds fault more particularly with the physical quantities mentioned in the report, among which he thinks numerous changes are necessary; he approves of Mr. Blondel's definition of "inductivity," which he says is simpler and no less exact; "impressed electromotive force" and the "coefficient of induction," he claims, are not defined with sufficient precision for international definitions; he also objects to the definition of "reluctivity," as he does not approve of a definition of a physical quantity which contains both a quantity and a unit; "reluctance per unit of volume," he says, is quite inexact and would correspond to saying that a velocity is a length per unit of time; a velocity is the quotient of the length by a time; he does not think it is within the province of the Congress to sanction the word "voltage," as also the other expressions of a like nature, which he says interests only English speaking people.

The Arc Light as a Standard of Light.—Mr. Blondel suggests using the light from the crater of an arc lamp as a new secondary standard, for use specially in measuring white light such as that from the arc. He calls attention to the fact that the temperature of the arc is constant and independent of the current, and he has found that the brightness of the crater is also constant within wide limits of the difference of potential, the current, and the nature and composition of the carbons. To use this as a standard, he places the carbon at an angle of 20 degrees with the vertical, in which case the crater will be inclined 50 to 60 degrees, and will be completely visible for an arc of from 4 to 5 millimetres; it is not necessary that the light is emitted perpendicularly to the surface of the crater; in front of the arc is placed a screen with a small conical aperture; this screen is made double so as to allow water to circulate through its interior, or a porcelain screen may be used. Over this



FIGS. 1 AND 2.—DIAGRAM OF HOT WIRE VOLTMETER.

screen is placed a small disc, having different sized holes, and a small lens, any of which can be brought in line with the opening; the screen is placed within 2 to 3 centimetres of the arc; an opening of one square millimetre is found to give the best results. The effect of this screen is to focus or to cut off, as it were, all the light except that from the crater; the photometer is then placed in line with this conical beam of light. To assure oneself that only the light from the crater is used, the small lens above-mentioned is placed in front of the hole, in which case a magnified image of the arc will be formed on a screen at the end of the photometer, from which it can be seen whether the light entering the photometer is that from the crater and not from the rest of the arc. A magnet may be used to direct the arc so as to keep the crater from changing its position; 70 to 75 volts (including the rheostat) and 0.2 amperes per square millimetre was found to give the best and most stable results; for instance, with 15 millimetre carbons, 75 volts, 40 amperes and 6 millimetres arc. He suggests that the Chicago Congress adopt as a secondary standard of light that emitted from the crater of an arc lamp; its value could be determined once for all in terms of the absolute standard. As it is not an absolute standard, it cannot be used as such, but merely as a convenient secondary standard. A full, illustrated description will be found in the bulletin of the "Soc. Int. des Electriciens" for March, and an illustrated abstract in "L'Ind. Electrique," March 25. (This proposed standard appears to be very similar to the one suggested by Mr. Swinburne.)

Apparatus for Investigating Slow Oscillations.—Mr. Blondel, in the "Comptes Rendus," March 6 (reprinted in full in the Lond. "Electrician," March 17, and "L'Ind. Elec.," March 25), describes a galvanometric apparatus which he calls an oscillograph, which allows one to make a direct observation of sufficient accuracy of the periodic curves of alternating currents. In such an instrument the moving parts must be able to oscillate with all variations; the variations may then be recorded photographically. In such an instrument there are five conditions; it must have a natural period of oscillation which is very short compared with that of the electrical oscillation; for frequencies from 40 to 100 its natural period should be at least 20 times as great; the damping should be as low as possible and as nearly as possible equal to the critical degree of dead-beatedness; the self-induction should be sufficiently small; hysteresis and Foucault currents should be negligible; the sensitiveness should be sufficient, which is the most difficult of all the conditions and involves exceedingly small moving parts. In examining various types he states that in the movable coil pattern the coil must be only a few millimetres in size; he suggests omitting the coil and using only the bifilar suspension, carrying a mirror at its centre; this has no self-induction. He gives a short description of the vibrating diaphragm pattern, resembling a telephone and proposed by Elihu Thomson, Froehlich and others. He thinks the movable bar pattern is superior, owing to the small dimensions and the smaller moment of inertia. This form he illustrates; it consists of a horseshoe magnet to the poles of which are attached thin iron trapezoidal pieces almost meeting and creating an intense oblong field between them; in this field, which is 3 to 4 millimetres wide, is pivoted a bar of soft iron about 2 or 3 millimetres wide; on either side of this field are the fixed coils through which the current passes; without a spring this produces more than 1,000 vibrations a second, which figure can be made much higher; with bifilar suspension or a spring it is easy to reach 2,000 or 3,000 with sufficient sensitiveness; the latter may be increased by reading with a microscope; the deflection is proportional to the product $G\ I\ 1\ P^2$, in which I is the intensity of magnetization, 1 the width of the bar, P^2 the natural period of oscillation and G the coefficient of action of the coils; it is therefore best to employ a very soft, narrow and very saturated piece of iron. The pole pieces are cut with numerous saw cuts which render hysteresis and Foucault currents quite negligible. Self-induction need be feared only when using this as a voltmeter with fine wire coils, but even then it may be reduced to a small value by adding a large dead resistance. The chief difficulty met with was in connection with damping; at high frequencies electromagnetic damping becomes insufficient as the necessary damping is proportional to the frequency, and recourse to mechanical means must be had; after rejecting india-rubber, he used liquids, and finds that Canada balsam gave satisfactory results, while water or glycerine were less satisfactory.

Measuring a Difference of Phase.—Mr. Claude, in "L'Ind. Elec.," March 25, gives the principles of an apparatus by means of which the difference of phase between two circuits or between the E. M. F. and the current may be measured directly. It consists essentially of a sort of pendulum capable of vibrating in one plane only, having a mirror at its lower end and a piece of soft iron near the end; opposite to one side of this soft iron and in the same plane is placed a fixed, permanent magnet surrounded by a coil, like a telephone magnet, and on the other side a precisely similar magnet with a similar coil; when an alternating current passes through the coil of one of these magnets, the pendulum will oscillate with the same period as the alternating current, and a beam of light thrown on the mirror will produce a band of light of a definite length on a scale; if at the same time a second current be sent through the second magnet, the pendulum will be influenced by both simultaneously and oppositely; if the currents are exactly in phase with each other and have the proper direction, the resulting oscillation will be zero, in which case there will be no band of light; if, however, they are not in phase with each other, a band of light will be produced, from the length of which the angle of difference may be determined; for direct reading the scale may be calibrated directly in degrees. As the measurements are most exact near the zero point, an angle of lag which brings the deflection near the maximum can be read with greater accuracy by reversing the connections of one of the magnets. The electromagnets should have a permanent magnet as a core whose strength is greater than the variations produced by the current; if not, secondary effects will be produced. The apparatus may be used without these permanent magnets, but in that case there will be an attraction for a negative as well as for a positive impulse of the alternating current, and the oscillation of the pendulum will thereby be doubled, while by using a permanent magnet a negative impulse will weaken the resulting field and will thereby produce an effect more like a repulsion. He gives the theory of the instrument and shows how the angle can be determined from the length of the band of light. On account of the self-induction of the coils it is necessary to introduce considerable external resistance in each circuit in order to make the effect of the self-induction as small as possible; it is also advisable that the two circuits are under the same conditions, that, for instance, they each have equal resistances and are branched from equal differences of potential; it is also of advantage that the natural period of oscillation of the pendulum be sufficiently great as compared with that of the current, as this will change the true curve into one which is more nearly a sine curve, for which the equation which he deduces applies more accurately. He suggests using this apparatus as an indicator of synchronism, in the coupling of alternators in parallel, in place of the usual lamp and transformer, which latter, he says, is not nearly as sensitive.

Voltmeter.—Mr. Asch, in the "Elek. Zeitschrift," describes a hot wire voltmeter of a German firm, possessing some interesting modifications (though we believe not new), of the form in which it is usually used in the Cardew voltmeter. The construction is shown diagrammatically in the adjoining Figs. 1 and 2. A platinum

silver wire .06 millimetre in diameter and 16 centimetre long is stretched horizontally between the adjusting screw s and a fixed support at the other end; at its middle point is fixed a brass wire m .05 millimetre in diameter and 10 centimetres long; to the middle point of this second wire is fastened a cocoon thread c, which winds around the axles containing the needle, and is secured to a flat spring p. When the platinum silver wire becomes heated by the current its elongation will enable the spring p to act and to turn the needle as shown in Fig. 2; it is evident that a very slight elongation of the wire will produce quite a large deflection of the needle; the method forms, as it were, a simple means for magnifying the effect of a small elongation, and by properly choosing the dimensions and the diameter of the little drum a large and definite deflection may be obtained with a very small consumption of energy in the voltmeter wire. In order to make the deflection independent of the external temperature, the base plate on which the wires are stretched is made partly of brass and partly of iron (e, Fig, 1), so proportioned that it will have the same coefficient of expansion as the platinum silver wire; the base plate is made sufficiently thin to enable it to take the temperature of the room as quickly as possible. The screw s is for adjusting the zero. The scale of the instrument is such that the readings are much larger at the upper end than at the beginning; by properly regulating the original tension a nearly regular scale can also be obtained. There is a thin sheet of metal above the wire to protect it from injurious air currents. As the wire is horizontal it has the same temperature throughout, which is not the case in the vertical instruments. It was tested up to a frequency of 100 and found to give precisely the same reading for continuous as for alternating currents; the self-induction is therefore quite negligible. The resistance of the wire is about 14.5 ohms for an instrument reading to 120 volts; the current is .2 ampere; readings as low as 3 volts can be taken on this instrument. For obtaining a full deflection for half the voltage the current is led through the brass wire and out at both ends of the platinum silver wire; for higher voltages auxiliary resistances of "constantan" metal are used; as the temperature coefficient of this additional resistance is zero, and as the wire forms but a small proportion of the whole resistance, the temperature coefficient of the whole instrument is said to be zero. For measuring currents, well conducting wires of larger diameters are used together with the indirect method of measuring. The large instruments have such large scale deflections that they can be read from a distance of 30 to 50 feet.

Astatic Galvanometer.—Messrs. Du Bois and Rubens, in the "Wied. Ann." describe an improved form of the Thomson galvanometer, a short abstract of which is given in the "Elek. Zeitschrift," March 24. It is claimed to be more sensitive, easy to handle, of more general application and not so sensitive to an insecure support.

Plumbago Clay Resistances.—The high resistances mentioned in the issue of March 18, made of plumbago and clay, Mr. Fisher, in the Lond. "Electrician," states have been used by him for a number of years and have proved to be very satisfactory; he has used them up to 15,000 volts; he finds the temperature coefficient very small. To show their toughness he heated a piece 4 inches long with 1,000 volts to a uniform red heat without producing any apparent disintegration. He thinks there is a great future for these resistances.

Temperature in Photometry.—Mr. Leicester, in the "Journal of Gas Lighting," states that there is an error in photometry which is often neglected, due to the influence of temperature; in testing the candle power of gas, for instance, he finds that it varies from 13.9 to 16 c. p. for temperatures varying from 46 degrees to 73 degrees F. (In this connection we might also call attention to the fact, which is not generally mentioned in connection with standard candles, that their value appears to depend very much on the temperature. In some photometric tests the writer himself found that in a moderately cold room the light from a standard candle was very far below the normal; it was, in fact, impossible to make it burn normally.)

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternate Current Motors.—In the "Elek. Zeitschrift," March 31, Mr. v. Doliyo-Dobrowolsky replies to the claims of Mr. Brown for the invention of the motor, which he described recently (see The Electrical World, Feb. 25, p. 138.) Mr. Dobrowolsky is the chief engineer of the Allgemeine Elektricitaets-Gesellschaft and constructed his first three-phase motor in the year 1889; it gave such good results that one of 3 to 4 h. p. was constructed; the Oerlikon company with whom they co-operate, sent Mr. Brown, who was their chief engineer at that time, to study this motor, and in connection therewith Mr. Dobrowolsky gave him a full description of the principles and the laws governing their construction; before that time no such motors had been built by the Oerlikon company; that Mr. Brown should have been a prior inventor is therefore not substantiated by facts. The article quotes at considerable length from the correspondence in which Mr. Dobrowolsky at that early date showed a thorough knowledge of the underlying principles. In this he proved that there should be as many lines of force and as few windings as possible; also that one should use as much iron as possible; the total magnetic resistance should be made very small in order that few ampere windings will suffice. The magnetic air gap should therefore be short and have a large cross-section and the saturation of the iron should be low. He therefore called Mr. Brown's attention to the fact that his (Brown's) invention of making armature windings of copper bars inserted through holes near the periphery was particularly well applicable to such motors, as the cross-section of the air space is thereby greater than that for teeth. Brown's adaptation of a short-circuited armature, made of bars of copper connected to common contact plates at the ends, is taken bodily from Mr. Dobrowolsky's German patent of March 8, 1889. That a low frequency was better was announced by Mr. Dobrowolsky quite a number of years ago; the

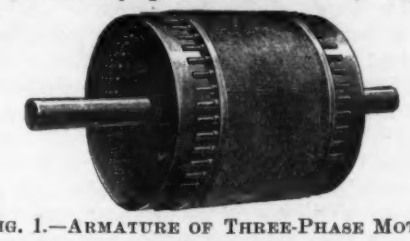


FIG. 1.—ARMATURE OF THREE-PHASE MOTOR.

original standard frequency 30 was subsequently raised at the instigation of the Oerlikon company to 40, and since then has been raised by the Berlin company to 50 in order that the current may also be used for arc lamps. He says that according to Swinburne the Brown motors cannot start well with a frequency greater than 25. The motor built by Dobrowolsky in 1889 had teeth on the stationary portions, but had no teeth on the armature portion, which shows that the improvement to do away with the teeth was not the invention of Brown, but that of Dobrowolsky; that there were teeth on the fixed portion, he said, is of less importance as his latest motors have been improved considerably by replacing the holes in the field by teeth which are wide at the end. The first practical multi-

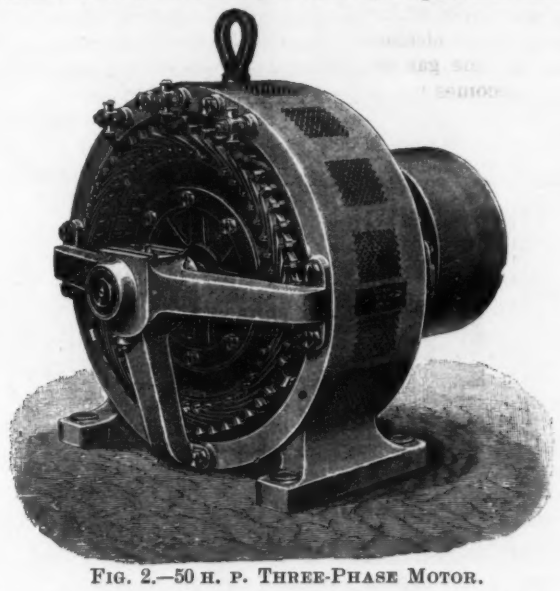


FIG. 2.—50 H. P. THREE-PHASE MOTOR.

phase motors were exhibited by his company, which, he says, Mr. Brown seems to have forgotten. He states also that the motors built by the Oerlikon company were improved by the engineers of that company after Mr. Brown left them, and it was not until then that they had the necessary starting torque. He then shows that Brown's motor is nothing more than the motor of Elihu Thomson improved by the addition of the Dobrowolsky short-circuited armature. The other methods of starting, described by Brown, are nothing more than the application of the suggestions of Ferraris, Hutin and Leblanc, which converts them for the moment into a rotating field motor; he, therefore, sees no originality in that portion of the Brown motors. He does not think the output per weight

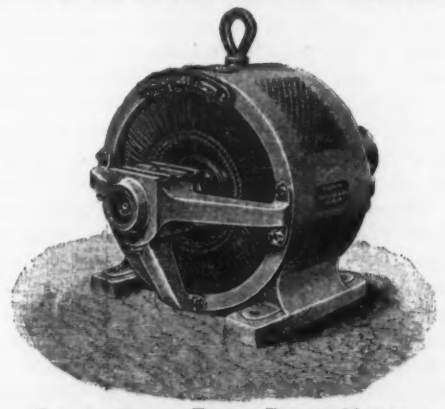


FIG. 3.—5-H. P. THREE-PHASE MOTOR.

is anything remarkable considering that the speed, 2,000 revolutions, is so high; to become "practical" motors the speed must be very much lower. He suggests having competitive tests made of his motors and those of Brown and opens the challenge by giving the data for three of his motors for 1, 5 and 50 h. p., which have neither brushes nor contact rings; they are built for a frequency of 50 and the load is that which they will carry on a continuous run without a rise of temperature of more than 40 to 50 degrees C.; it is therefore quite permissible to run them for a short time with a much higher output; they may be given a much larger starting torque if it were permissible to take their current from the mains. The data for the starting torque is of special interest. The data referred to will be found below under the heading "Latest Form of Three-Phase Motors."

Latest Form of Three-Phase Motors.—Mr. v. Dolivo-Dobrowolsky, before the Berlin Society, showed the latest forms of the three-phase motors constructed by the Allgemeine Elektricitaets-Gesellschaft, of which he is the engineer. The first motor was built in 1889, subsequently a larger one was built, and since then the one used in the Lauffen-Frankfort power transmission. The advantages of three-phase motors, he says, have now been recognized to such an extent that they are at present being built in various forms by nearly every electrical company in Germany, which proves the correctness of his judgment in originally introducing them. At first the larger motors were provided with contact rings for the purpose of being able to use resistancee in starting; he has now, however, improved them to such as extent that he can dispense with all contact rings and sliding contacts. In the accompanying illustration Fig. 1 shows the type of armature used in all these machines; Fig. 2 shows a 50 h. p. motor and Fig. 3 a 5 h. p. motor, both of which were built for the World's Fair and will be on exhibition there. Some of the data for these motors is given in the accompanying table:

DATA FOR THREE-PHASE MOTORS.

Output in h. p.	½	½	1	5	50
Consumption in watts	230	518	985	4,380	40,200
Amperes per phase, loaded	1.4	4.0	8.0	36	280
Volts per phase	60	60	60	60	60
Frequency	50	50	50	50	50
Speed, unloaded	2,380	1,490	1,490	1,490	745
Speed, loaded	2,300	1,400	1,375	1,395	725
Total efficiency in per cent	....	71	7.	84	91
Number of poles	2	4	4	4	8
Weight in pounds	396	1,386	2,068	5,390	26,400
Amperes, per phase, unloaded	....	....	4.5	15	150
Amperes, per phase, at starting	....	....	2	50	400
Watts (total) at starting	....	....	1,40	5,650	30,000
Starting torque in kilogr. × metres	....	....	.4	2.6	49.4

Alternate Current Motor.—Mr. Deri, in the "Zeitschrift fuer Elek.," March 1, describes his new motor. It is in general constructed like an ordinary shunt motor for direct current, having a Gramme ring and a commutator, only that instead of having all the coils connected in series as usual, the two ends of each coil, or group of coils, are connected to two opposite commutator sections, and are therefore insulated and disconnected from all the other coils or sections; the current from the brushes, therefore, traverses only one coil at a time, or two in parallel. The windings may be modified in various ways; in one of these two diametrically opposite coils of the Gramme ring are connected in series as one coil; in another one end of each coil is connected to a common slide ring, the others only being connected to the separate commutator bars; in another, several coils, symmetrically placed, are connected in series or in parallel. In all these forms the current passes through those coils which are in a position so as to produce the maximum torque in the magnetic field. The armature may be said to be subjected to two inductive actions, first, that due to the alternation in the field (which action is independent of the motion of the armature), and secondly, that due to the rotation, which evidently depends on the speed. He shows this graphically and finds that the voltage due to the former is greatest along the theoretical neutral axis and is zero at right angles to this; the other action is greatest when the former is least and vice versa. The E. M. F. of the circuit is taken equal to that of the armature coil situated at the neutral axis, and as they are opposite there will be theoretically no current; but if the brushes are displaced in either direction from the theoretical neutral axis, the applied E. M. F. will be greater than the counter E. M. F., and a current will flow which will produce a torque. The shunt fields are in one sense the primaries of a transformer whose secondary is the armature; if properly proportioned such a motor is said to be very easily regulated. The motor is started by displacing the brushes sufficiently to produce the required torque; as the speed increases the counter E. M. F. also increases, and the brushes are further displaced as much as is found necessary. By moving the brushes in the opposite direction the motor is reversed, which is claimed can be done quite sparklessly. As the torque can be regulated no external resistances are required. It is also possible to obtain a large torque at a slow speed without great expenditure of energy, as the motor, in virtue of its transformer action, can develop a large current at small pressure. The motor may be said to be a transformer with two primary currents, the one in the field and the working current in the armature; the latter current is opposed by the secondary current induced in the armature. For railway work the only regulator would be a device for shifting the brushes. The machine is said to be very efficient. (Nothing, however, is said about its output per weight, which, owing to the large amount of dead wire on the armature, is probably very low.) Diagrammatical illustrations of the windings will be found in an abstract in the Lond. "Electrician," March 31.

TRANSMISSION OF POWER.

Electricity versus Compressed Air.—In a paper before a German society, Mr. Cox gave a comparison of the complete costs of a system of transmission of power by electricity and by compressed air, including all machinery, lines, pipes, motors, etc. The power to be

transmitted was 217 h. p., and the distance 18,000 feet. For compressed air and electricity respectively, the figures were as follows: Cost of whole plant (including motors), 150,000 and 110,000 marks; guaranteed efficiency, 46 per cent. and 69 per cent. (with a 15 per cent. loss in the lines); horse power received at the end station, 100 and 150; cost per effective horse power, 1,500 and 754; cost of operating per effective horse power per year, 110 and 73; the same per hour at 10 hours a day and 300 days a year, .0367 and .025. The costs are all in marks (one mark is equal to about 24 cents). It will be noticed that the results are very greatly in favor of the electrical transmission. (The costs for the compressed air plant we believe were founded on a plant in actual operation.)

Belting.—Mr. Mavor, in a paper reprinted in part in the Lond. "Elec. Eng.," March 31, gives an interesting discussion of the subject, with particular reference to the most difficult case, namely, driving small pulleys at high speed and with short distances between centres. He discusses the formulas of Rankine in his "Treatise on Machinery and Mill Work," page 351, and calls attention to the importance of the coefficient of friction which at the same time is the most difficult element to determine; although much has been written on the subject, authorities are hopelessly at variance in their results, the reason for which is the very great effect of different conditions, such as smoothness, dryness, temperature and flexibility of the belt; the results of different experimenters vary as much as 300 per cent. He mentions the exhaustive experiments made by Wm. Sellers & Co., published in the transactions of the American Society of Mechanical Engineers, 1886; these show that the coefficient of friction of the same belt may vary 1,000 per cent. He himself has obtained an average value of 1.53; Rankin gives .42 and states that .22 is ordinary practice, but that .15 is to be taken if there is any possibility of the belt becoming oily. In the latter case, however, Mr. Mavor states that it may vary almost to zero. He has not much faith in Rankin's formulas. He states that as a general rule the assumption of a low coefficient of friction will assure satisfactory results, as there is plenty of margin in the strength of a belt to permit of increase in the tension so as to get the required resistance.

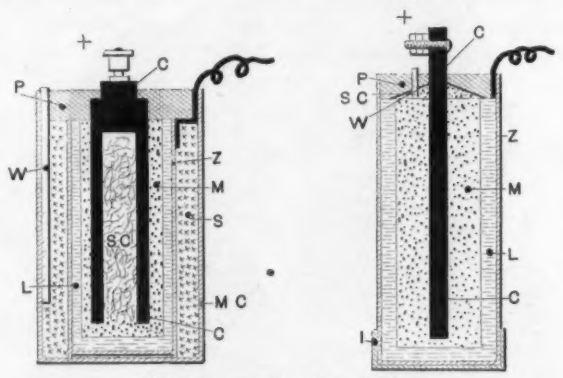
CENTRAL STATIONS, ETC.

Lightning Arresters.—Mr. Wurts (who is presumably a good authority on the subject), in an article in the Lond. "Electrician," gives the following information about lightning arresters in the United States. In the Eastern States thunder storms seem to be local; in stations 50 miles from each other he repeatedly found that in one troubles from lightning were incessant, while in the other a thunder storm was almost unknown. Storms are particularly violent in the Mississippi Valley and at the Rocky Mountains. Railway plants suffered less, but this he says is due to the roads being shut down during storms. In Colorado there is a railway plant which is forced to shut down for an hour or two nearly every afternoon during the summer, while further west there are lighting plants which were almost inoperative during the afternoon of the summer months.

He divides protective systems into two classes, one in which a simple discharge circuit with a spark gap is used, in the other the accumulation of charge on the line is prevented by stretching near and parallel to it a bare wire thoroughly grounded at frequent intervals; the first method is a cure and the latter a preventative; both involve difficulties, but the latter he thinks is the more efficient of the two. Regarding the first method he states that disruptive discharges form nodes, at which points there is little or no tendency to discharge, and if a spark gap arrester be at a node, the discharge will be more likely to occur at some other point; as these nodes shift their position, an efficient protection can be secured only by having a large number of arresters. He recommends 3 or 4 per mile in exposed districts. When spark-gap arresters are connected to both legs of a circuit a discharge will almost invariably occur at both points at the same time, short-circuiting the generator; an arrester must, therefore, interrupt this short circuit, and automatically adjust itself for a succeeding discharge. Besides being simple and cheap it should be free from moving parts and have no fuses. He then describes his non-arcing arresters, which were fully described in these pages a year ago. (See The Electrical World, March 26, April 2, and April 9, 1892.) These are based on the discovery that between electrodes of certain alloys it is not possible to maintain an arc across a gap by an alternating current. The alloy used is composed of zinc with a certain proportion of copper. One of the most remarkable features is that it manifests non-arcing properties only when the air gap is very small; 2,000 of these have been in use during the past season and not one of them has failed. They are apparently not applicable for direct currents. Magnetic "blow out" arresters, he claims, are not good because the gap is often fused before the magnet has time to act. He quotes cases in which the protection, by means of a barbed wire stretched on the tops of the poles and grounded over 700 feet, was very effective. In large cities where high buildings and church spires protect the wires, lightning arresters are seldom used. When arc and incandescent circuits are run on the same poles, lightning discharges occur on the former while the later are comparatively free from trouble.

Relative Cost of Different Systems.—The "Elek. Zeitschrift," March 24, gives a short abstract of the very exhaustive report made on the proposed systems for the city of Frankfort-o.-M. It is of interest, but unfortunately the abstract does not state whether the lamps are 8 or 16 c. p., and therefore it is of comparatively little value. Five systems were compared: One by Siemens & Halske for a five-wire system with accumulators, one by Schuckert for alternating currents transformed to direct currents and used with accumulators, one by Lahmeyer for three-phase currents transformed into direct currents and using accumulators, one from Helios using simple alternating currents, and an estimate for a simple alternating current plant, made by the municipal engineers. The relative prices in marks (one mark equals about 24 cents), per lamp burned, for an installation of ~~,000 lamps fusing at one time, were, respectively: 162.7, 155.5, 154.9, 128.1 and 115.5; for 67,000 lamps, 114.7, 114.3, 113.2, 96.1 and 83.7. The following costs per lamp hour in pfennigs (100 pfennigs equal 1 mark) were: for the small installation 1.78, 1.79, 1.77, 1.61 and 1.47; for the larger, 1.31, 1.39, 1.38, 1.24 and 1.07.

Gas Engines.—"L'Ind. Elec.," March 25, calls attention to the poor efficiency of the steam engine and the higher efficiency of gas engines, and to the consequent advantages of using the latter for central stations. It calls attention particularly to the use of what is called poor gas, that is, gas which is poor for illuminating purposes, but is very cheap and economical for motor purposes. The article describes and illustrates a cheap gas generating apparatus and a gas engine which is used in a small central station in France, where it is said to give great satisfaction. The generating apparatus consists in general of a closed furnace in which the coal is incompletely burnt in connection with a small amount of water vapor; the products of the incomplete combustion, after passing through cleaners, are collected in the gasometer and used in the gas engine. The gas generating apparatus thus becomes very cheap, but it contains 55 per cent. of



Figs. 1 and 2.—Dry Cells.

nitrogen, carbonic oxide and oxygen, which are all of no use in developing power in the gas engine.

Paddington Station.—The Lond. "Elec. Eng.," March 31, concludes its description of this station, which is said to show the very latest alternate current practice in England. The present portion is devoted largely to a detailed description of the switchboard, of which a good illustration is given.

TELEGRAPHY, TELEPHONY, ETC.

Telephone System in Vienna.—Dr. J. Hopkinson recently made a report on the telephone system of Vienna, which is reprinted in full in the "Elek. Zeitschrift," March 24, and in abstract in the Lond. "Elec. Rev.," March 31. He states that speech is transmitted louder and clearer than in London, Paris or in Berlin. The rapidity with which conections are made, he states, is better than in any other city that he knows of; he finds that it takes from 25 to 75 seconds from the time the call is sent to the time the connection is made; during busy hours it may require from 90 to 100 seconds. In Berlin it was from 1½ to 2 minutes, in Paris he found it to be from 3 to 4 minutes, although some claim that it is often very much longer; in London the shortest time was 1 minute, and in some cases he found it to be 2¾ to 5 minutes; he thinks that a fair mean would be 2 minutes. The reason that it takes so little time in Vienna he attributes to the fact that there is only a single station with three multiplex switchboards, while in London there are many separate central stations; in Paris there are 10, in Berlin 12 to 13. In the last two cities it is the intention to diminish the number of central stations. There is more induction and cross-talk in Vienna than in Paris, which he attributes to the many air lines in the former city, as also to the ground return. He calls particular attention to the exceptionally good underground cables used in Vienna; in more than 70,000 wires which were laid only 20 have been faulty, and even in these cases it was through mechanical injury; he sees no reason why they should not remain permanently in this good condition. The cost of the cables he finds is about the same as that of the cheapest ones used in Paris, or even, perhaps, a little less. A switchboard for 3,000 subscribers and for metallic circuits costs, complete with all accessories and cable connections, about $95,000; the cost increases almost as the square of the number of subscribers. The subscription price in Vienna is about $42 a year within a radius of 1.2 miles of the central station; in London it is over $100 and in Paris about $80; in Berlin it is about $38 within a radius of .6 mile. In general the report is very favorable.

Telephones in Large Offices.—The Lond. "Electrician," in commenting on the fact that after a certain number of subscribers are connected to a central station, the system becomes unwieldy, and the profits are diminished rather than increased in large buildings, containing many offices, it therefore suggests having all the telephones of that building connected to one switchboard operated by the "hall porter" and that a proportionally low rate be then charged. This would increase the income of the company without increasing its expenses.

Telegraphing Between Trains in Motion.—Mr. Etienne is reported to have made experiments in Algiers with a new system of telegraphing between trains which are said to have been very successful; no description, however, is given. It is claimed that it will revolutionize modern railroading in that it will avoid collisions, delays, misunderstanding of signals, etc., due to the present forms of signaling.

Telegraphic Feat.—The University boat race in England ended at 4 hours 52 minutes and 47 seconds, the name of the winning crew was received in the London office of the Dalziel Agency at 4 hours 52 minutes and 48 seconds, and at New York 4 hours 52 minutes and 50 seconds, Greenwich time; the result was therefore known in New York three seconds after the race was finished.

ELECTRO-CHEMISTRY.

Tests of Dry Cells.—Prof. Jamieson, in a paper before the Philosophical Society, reprinted in full in the Lond. "Elec. Rev." and in abstract in the Lond. "Elec. Eng.," gives very exhaustive comparative tests of the Hellesen and the E. C. C. dry cells. He refers to the Munich tests, which show that out of six different kinds of dry cells the Hellesen was the best (the original report appeared in the "Elek. Zeitschrift," Aug. 1, 1890, and an extract in the Lond. "Electrician," Feb. 6, 1891). He has himself used them and finds them much more convenient than the wet cells; he also found that the E. C. C. cells (a London make) were quite as good. From the Munich tests the Hellesen cell gave 2.39 ampere hours, while the Bender gave 2.34 ampere hours on closed circuit through an external resistance of 50 ohms for 96 hours; with 3 ohms for 24 hours they gave 5.08 and 4.99 respectively. The construction of the Hellesen and the E. C. C. cells is shown in the accompanying cuts. In both C represents the carbons, which in the Hellesen cell in Fig. 1 is hollow; M is manganese dioxide, etc.; L, lime and sal-ammoniac, etc.; Z, the zinc retaining cell; P, pitch covering; W, waste tube; SC. in Fig. 1, is silicate cotton; S, sawdust packing; MC, millboard case. In Fig. 2, showing the E. C. C. cell, SC is cotton, I is an insulating base. The composition of the two pastes is given in the paper. The black paste M in Fig. 1 consists of 25.54 per cent. of MnO_2, 16.02 of carbon, 12.76 of SiO_2, 12.88 of MgO, 28.38 of moisture and undetermined ingredients, and traces of iron and calcium. That in Fig. 2 consists of 7.57 per cent. of MnO_2, 47.26 of carbon, 7.20 of MgO, 12.78 of NH_3. The white paste in Fig. 1 consists of 26.18 per cent. of CaO, 6.0 of ZnO, 2.49 of NH_3, 64.82 of water and binding material. That in Fig. 2, of 20.89 per cent. of CaO, 20.29 of NH_3, 6.31 of Cl, 52.51 of water and binding materials. The results of the tests will be given next week.

Tanning.—The Lond. "Electrician" describes the Pinna process of electric tanning, as follows: The hides are submitted to the action of alternating currents while immersed in the tanning liquor. A metal electrode is placed at the bottom of the pit, and the hides are piled one upon the other. The tanning liquor is then run in. The current density required is from ½ to 1½ ampere per square inch, according as the skins are light or heavy. The frequency of the alternations should be not less than 43. The arrangement described can obviously be adopted in the usual pits, but the vertical suspension of the hides side by side between vertical electrodes has given better results, and permits individual hides to be examined during the process. It is claimed that 100 to 400 hours, according to the quality of the skins, is sufficient for the process. According to M. Pinna the advantage of employing electricity lies in the fact that it materially assists the penetration and diffusion of the tannin into the skins in consequence of the physiogical action which electricity exerts upon the cellular tissues. Continuous currents, resulting in electrolysis of the tannin, give rise, in his opinion, to deleterious reactions.

Electrolysis in Photography.—Mr. Leisegang, in the "Photo. Archiv.," describes the following method for developing plates. A nearly saturated solution of acid sodium sulphite is electrolyzed in the developing dish, the cathode being a platinum plate in the dish and the anode being in a porous cell to prevent mixing of the liquids formed; a half dozen dry cells give sufficient current; when a full exposed bromide plate is immersed in the bath a brownish red image is developed in a few moments, the oxidation of the solution by the air or by the development being reduced immediately by the action of the current. The image fades somewhat on fixing, but retains its characteristic color. A few other details will be found in the Lond. "Electrician," March 31.

The Central Station of the Akron General Electric Company.

The Akron (O.) central station, like many pioneer electric lighting stations, has quite an interesting history. It had its birth in 1882, when the Brush company, of Cleveland, erected in the city of Akron a mast 210 feet high, placed thereon four lights of 4,000 c. p. each, and established a comparatively small light plant, which it subsequently disposed of to the city, which operated it for a period of about a year. In April, 1883, the Akron Electric Light and Power Company was formed, with an authorized capital of $50,000, for the purpose of selling arc light and power for commercial purposes. The Brush company also furnished the apparatus for this plant. Later this same company purchased a large storage battery plant, of the Brush-Swan system, and entered the field of incandescent lighting. This system was operated for some time, with rather indifferent success, however. In August, 1884, the Citizens' Electric Light Company was formed, with an authorized capital of $60,000, and entered into a contract with the city to furnish 100 arc lights, agreeing to accept the Brush plant, which the city was at that time operating, in part payment for its services. This company purchased an additional outfit of arc apparatus from the Thomson-Houston company; also a direct current Weston machine of 140 volts, running two 70 volt lamps in series. For a while both the Citizens' Electric Light Company and the Akron Electric Light and Power Company struggled for supremacy, the advantage now with one company and now with the other, until finally a combination of interests was effected under the name of the Akron Electric Company, whose capital stock was fixed at $250,000.

At this time the plant consisted of one 1,500 light Westinghouse alternating current dynamo, eight Thomson-Houston arc dynamos, and the original Weston dynamo, the storage battery system having been already abandoned. The business was carried on with this equipment for some little time, until about Jan. 1, 1892, when Mr. Ira M. Miller, the president of the company, purchased the controlling interest and reorganized the company as the Akron General Electric Company, with an authorized capital of $300,000. Mr. Miller then actively began the reconstruction of the entire plant, giving his personal attention to the arrangement of all the plans and details, which were energetically pushed to completion under his direct superintendence. An order was given to the Pennsylvania General Electric Company for the additional electrical equipment, consisting of two 100 kw. 500 volt power generators, two 120 kw. alternating current incandescent dynamos, one 60 kw. alternating current incandescent dynamo, four 50-light arc dynamos, and a complete new switchboard of modern design, the building having been remodeled and an entire new steam plant, consisting of boilers, engines, heaters, etc., having been added.

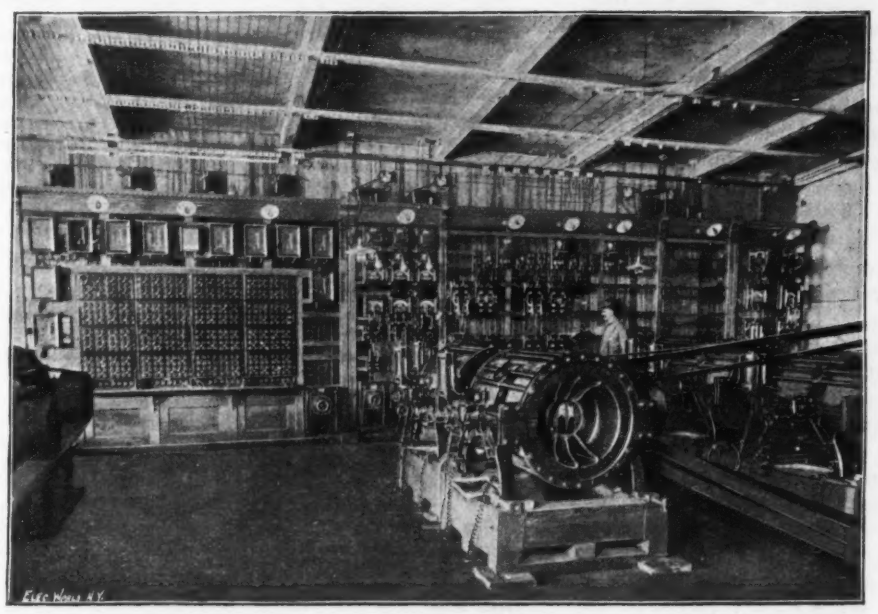
The arc circuits aggregate 150 miles of pole line construction; the incandescent circuits are gradually spreading out over the entire city, and many of the fine Akron residences are now lighted by incandescent light, which is registered by the Thomson recording wattmeter. Current for motor service is also sold in the same manner. The entire pole line construction is being remodeled and increased, all construction being of the most substantial and permanent character.

Situated as the plant is between the Ohio canal on one side and the Belt Line Railway on the other, the conveniences for handling coal are of the best. The railway tracks pass the building on a level with the second floor and coal doors are so located that coal can be thrown from the cars into bunkers immediately in front of the boilers. In case of strikes or blockades interrupting the supply of coal by rail, a canal boat can be tied up at the very door of the boiler house and coal supplied from that source.

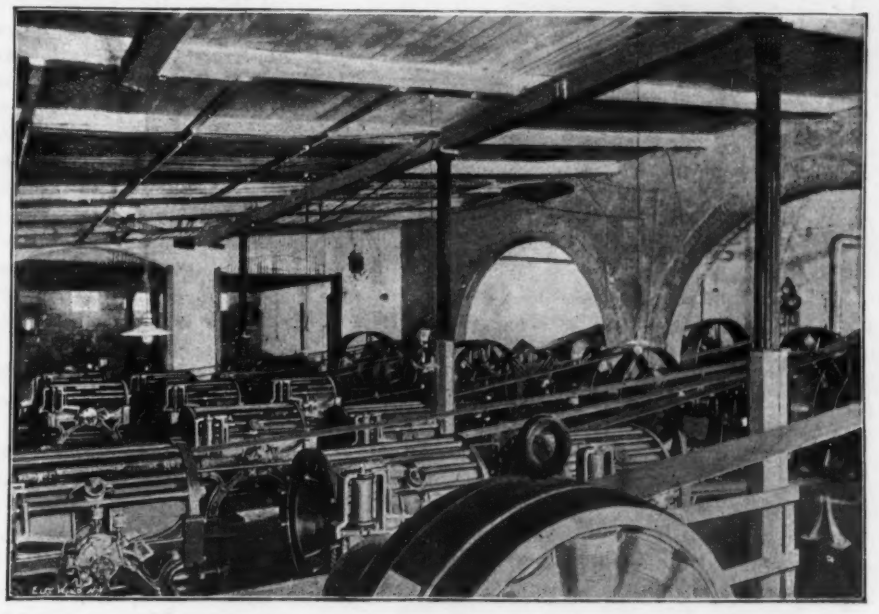
The steam plant consists of four cross compound condensing Armington & Sims engines, 16½ × 25 × 15 inch stroke, rated at 300 h. p. each; two Stirling water tube boilers, having a total capacity of 800 h. p., with foundations in place for an additional battery of 400 h. p., together with Morse heaters and Davidson pumps and condensers. The condensers are located in a water-tight compartment immediately under the engine room. Passing under the condensing room in a tightly inclosed cemented aqueduct is a fast running subterranean water course which supplies water power to several of Akron's great cereal mills. By tapping this back a little from the condensing room it is brought to the condensers by gravity, and in leaving them it is returned to the water course in the same manner. The pumps and heaters are located in a section of the boiler room separated by partitions. Morse heaters and Davidson pumps are used.

The engines are arranged in a row, Nos. 1 and 4 being belted to the main line of shafting, from which are operated one 70 kw. Thomson-Houston alternator and 12 Thomson-Houston arc dynamos. The shaft is cut in the centre but can be connected by clutch pulley, and the two engines may be also connected or disconnected from the shafting in the same way. This enables either engine to operate the full line of shafting or they can be operated separtely dividing a load between the two. The shafting and pulleys are from the Hill Clutch Works, Cleveland, O.

Engines Nos. 2 and 3 are belted direct each to one multipolar power generator of 100 kw. capacity, and one 120 kw. Thomson-Houston alternator, making a duplicate plant for both power and lighting service and an uninterrupted service regardless of accidents. A 60 kw. Thomson-Houston alternator has also been ordered and will be on the opposite end of the line shaft from that occupied by the 70 kw. machine.



Switchboard.



Dynamo Room.

THE CENTRAL STATION OF THE AKRON GENERAL ELECTRIC COMPANY.

Arc and incandescent circuits leave the building through a tower built over the dynamo room, the wiring being very carefully arranged and insulated in the best manner possible.

The switchboard is one of the most beautiful and well aranged in Ohio. It was designed and built by the Engineering Department of the Pennsylvania General Electric Company through its Pittsburg office. The frame is of seasoned oak finished in oil, and the apparatus is all of the latest improved style made by the same company. The arc section is the first to the left, as shown in the cut, and consists of a 16 circuit slate plug board made expressly for this station. The wall controllers are arranged round the slate, making the board a very compact and easily handled one. By means of this switchboard any combinations of circuits can be made with any desired combination of dynamos; thus, should machine No. 1 be thrown out of service for any reason, its load, which is the Sixth ward circuit No. 9, can be thrown on another machine or a combination of machines, as might be convenient. The lightning arresters are all arranged in rows along the wall back of the board.

The incandescent board occupies the centre of the frame, and is so arranged as to make a complete transfer board, and any desired arrangement of dynamos and lighting circuits. The rheostats are located at the bottom of the board with one behind the other, bringing the wheel for operating within easy reach of the operator. Room has been left on this part of the board for the addition of as much more incandescent apparatus as is now in use.

To the right of the incandescent board is the power switchboard, to which are now connected the two 100 kw. 500 volt power generators which furnish power for commercial use to the various factories and industries of Akron, one plant alone, the Akron Cordage Company, using some 60 h. p. The power business is rapidly gaining favor, and the 24 hour service supplied by the Akron company has done much to increase the value of electrical power service to Akron business houses.

Above the dynamo and engine room is the testing room, where all arc and incandescent lamps are examined and tested before being placed in circuit. On this same floor are also the rooms for arc and incandescent supplies.

Twelfth Annual Meeting of the American Street Railway Association.

The executive committee of the American Street Railway Association announces that the Milwaukee Industrial Exposition Building has been secured for the exhibition of supplies and manufactures of every nature used in the street railway business, in connection with the twelfth annual meeting of the association which is to be held in the city of Milwaukee, Wis., commencing the third Wednesday in October, 1893, and lasting three days. The building has been engaged for two entire weeks, beginning Oct. 9 and ending Oct. 23, in order to give ample time for the setting up and removal of the largest and heaviest exhibits.

The New Sunbeam Lamp.

The new incandescent lamp patented by John Van der Kammer has now been placed on the market under the name of "The New Sunbeam Lamp," by the Star Electric Lamp Company, of Chicago, and it will no doubt be of interest to many to know something of the peculiar qualities of the lamp in its commercial form.

The mechanical construction of the lamp embraces the features of a glass globe combined with a metallic base, somewhat after the manner of some of the very early lamps which preceded the vacuum lamp, the circuit being formed by wires secured to the inside of such base, and to the burner, the two ends of which are connected to the two inside wires in much the usual manner. Thus the conductors pass through the metallic portions of the receiving chamber, as in some of the earlier lamps.

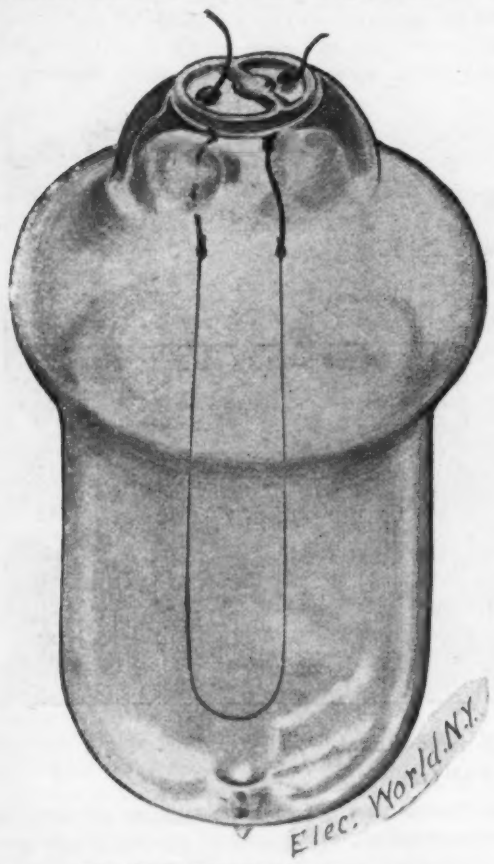
The difference in expansion between the metal base and the glass globe is of no consequence in a lamp constructed in this manner, for there is sufficient flexibility in the metal to permit it to accommodate itself to the expansion of the glass. The metal base can therefore be made of one of the cheaper metals, prepared to resist the action of the inclosed gas, and the manufacturers promise soon to employ such a metal in place of the platinum now used.

The fact that the New Sunbeam may have a comparatively high pressure of gas within it renders the maintenance of a perfect vacuum chamber of less consequence than in the vacuum lamp, and therefore permits the change in the construction which is set forth in the mechanical patent on the lamp. A seal which would not be satisfactory for a vacuum lamp might be entirely satisfactory for a gas lamp. The metal seal at the base obviates the necessity of joining glass to glass in the usual manner, and also the use of the internal seal piece, so that if the lamp is slightly damaged in the process of its manufacture it may be conveniently repaired and resealed at the lower end. Moreover, this form of base and construction permits the reusing of the bulb and metal plates, and the manufacturers offer inducements to users for the return of unbroken bulbs, or of the butts.

While the novel features in the mechanical construction of the lamp are striking the results attained by the use of gas in the lamp, both as to the properties of the complete lamp and as to the methods of its manufacture, are both surprising and gratifying.

The inventor of this lamp has abandoned the idea of perfecting the vacuum lamp for the reason, as he claims, that being based upon the idea of a perfect vacuum, and a perfect vacuum being unattainable, the vacuum lamp must of necessity retain within itself the cause of its own early destruction, and in practice it is found that, as ordinarily made, it is quickly destroyed by comparatively slight excess of current. This inventor therefore

set himself to the task of constructing an incandescent lamp on the principles set forth in the earlier gas lamp patents and publications concerning the incandescent lamp. Several difficulties were found with the earlier gas lamps, as, for example, it was found that the gas in the lamp, even though greatly attenuated, would tend to disintegrate or destroy the burner, possibly by the impact of its highly heated particles upon the surface of such burner. It was also found that there took place a process, which has been described as electrical carrying, which rapidly destroyed the burner, and that with such gases as were then known there was great loss of energy from the heating of the gas in the lamp. There were many other difficulties with the gas lamps, which finally resulted, as it appears, in the abandonment of the idea of producing a gas lamp and the substitution therefor of a vacuum lamp. This inventor has turned again to the gas lamp as a means of avoiding the weaknesses of the vacuum lamp, and has endeavored to produce a gas lamp which should not have the objectionable features of the early ones. It often happens that a process, for a long time abandoned as impracticable, is revived and rendered of great utility by the ingenious effort of some inventor, who is not intimidated by the general adverse opinion, and so in this case, although the gas lamp has for years been declared impracticable, the inventor by the employment of sundry ingenious expedients has produced a lamp which does not appear to show any of the objectionable features of gas lamps as formerly made, and which is not liable to the weaknesses shown by the vacuum lamp. The new lamp, though containing a considerable quantity of gas, appears to be even cooler while burning than the ordinary vacuum



The New Sunbeam Lamp.

lamp. There is no disintegration of the carbon and no electrical carrying incident to overwork, even when greatly overrun. For example, when a 100-volt lamp is run at 150 volts for a considerable time the burner will be found to be of its normal color throughout, and practically unchanged. Moreover, the character of the gas employed is such that whatever injury the burner receives or tends to receive from such overrunning is promptly and completely repaired by the gas itself, so that in most instances when the lamp has thus been overrun it will be found not only that the burner is unchanged in its form and appearance, but that its resistance is actually slightly diminished so that, for example, a 110-volt lamp burned at 160 volts for a short time will give the full candle power at 109 volts instead of 110.

Some of the delays in producing the lamp are attributable to the difficulty of obtaining the gas producing substance in sufficient quantities to answer the purpose of the manufacturer. The gas which is employed is produced from a very rare substance, and one which the inventor and the chemical experts of the company assert has never before been used in connection with incandescent lamps and which it is very difficult to obtain. It appears, now, that all such difficulties have been removed and the lamp will therefore be manufactured in quantities. The manufacturers of this lamp claim for it great utility for certain uses, on account of the quality above referred to, as for example, on all such circuits as are supplied with currents of varying pressure.

The fluctuation of several per cent. in the current will not injure the lamp nor increase the resistance of its burner, at least, not until such fluctuations have extended over a long period, or in other words, the practical life of the lamp.

But not only does the lamp show such peculiarities in its service as above suggested, but the manufacturers claim that there is a great change in the method of manufacture. Gas being constantly present in the lamp, and the means of preserving or repairing the carbon being constantly at hand, the lamp requires no such elaborate process of manufacture as does the vacuum lamp. In the vacuum lamp every effort must be put forth to secure an initial vacuum of the highest possible degree, and to drive out of the lamp and the parts contained therein the last trace of such occluded gases as may tend to remain therein, and this requires an expensive process of pumping and electrically energizing the lamp during such process of pumping. Moreover, after this high degree of vacuum has been obtained, it is necessary that the lamp should be so constructed as to retain the vacuum and permanently exclude all atmosphere from the lamp and close it against practically the whole of the atmospheric pressure. Now in the New Sunbeam Lamp, since there is a gas left permanently in the lamp, it is plain that such perfect exhaustion of the lamp and its parts is unnecessary.

The End of Mr. Martin's Suit.

In January, 1891, Mr. Thomas Commerford Martin—who for several years had been the editor of The Electrical World, and who was discharged from such employment in March, 1890—commenced an action against Mr. William J. Johnston and The W. J. Johnston Company, Limited, in the Superior Court of the city of New York. He claimed that he had been wrongfully discharged, and that he was entitled to recover from Mr. Johnston the compensation which his agreement provided he should receive for the year 1890.

Soon after the action was brought the trial of the same was referred, with the consent of Mr. Martin, to Hamilton Odell, Esq., counsellor at law, as referee, to decide all the questions which the suit involved, and the trial before Mr. Odell was commenced in June, 1891. Right at the outset of the trial Mr. Martin tried to secure judgment against Mr. Johnston in a technical way. The Referee intimated that in this he could not succeed, and by doing so compelled Mr. Martin to go into the merits of the controversy. Mr. Martin was then, upon his own request, allowed to furnish further evidence which he thought would enable him to succeed without relying on his technical position. After this several witnesses were examined and the trial progressed until January last, when it was finally submitted to the Referee.

As to the technical position taken by Mr. Martin a word may be necessary. Some of the readers of The Electrical World may recall the fact that the issue which was distributed at the electric light convention in Kansas City, in February, 1890, contained no editorial notes. The absence of these notes in that issue was explained in the paper at the time as having been caused by a misunderstanding. This "misunderstanding" the proprietors of the paper at that time, and since, have always thought Mr. Martin was responsible for; and holding him responsible for that led to other misunderstandings between him and Mr. Johnston, which ended in his discharge as editor of the paper on March 5.

Several months after Mr. Martin's discharge Mr. Johnston wrote the letter of June 7, referred to in the Referee's report which follows, asking Mr. Martin to name a price for the stock which he held in The W. J. Johnston Company, and which Mr. Johnston under agreement had the right to buy. By this letter Mr. Martin sought to show that Mr. Johnston admitted that the contract remained in force until the end of 1890, although he had been dismissed in March previous. This, of course, was nothing more than refined legal technicalities containing no merit. Were it not for this letter, hoping to succeed by its use, Mr. Martin's action would never have been heard of.

On the 14th of the present month the Referee filed his decision in the Superior Court. The decision is in favor of Mr. Johnston and The W. J. Johnston Company, Ltd., and in it he decides that Mr. Martin has established no grounds for any action against the defendants, and that the defendants are entitled to have judgment entered in their favor dismissing Mr. Martin's complaint with costs.

Thus ends Mr. Martin's effort to make Mr. Johnston pay him money which he never earned, an effort based upon a letter of Mr. Johnston's written honestly and in good faith, for the purpose of carrying out the agreement between them—a letter which in fairness never should have been used for any such purpose.

The following is the Referee's opinion in full:

The complaint set forth an agreement made between the plaintiff and the defendant Johnston, and alleges a breach thereof by said defendant, and the relief demanded is that the plaintiff recover of said defendant the sum of $2,500 and interest, and that the defendant be required to specifically perform the said agreement, in part, by the delivery to the plaintiff of twenty shares of the stock of the defendant The W. J. Johnston Company.

For several years prior to the making of said agreement the defendant Johnston had been the proprietor and publisher, in the city of New York, of a newspaper called The Electrical World, and the plaintiff had been employed as one of the editors thereof. In the latter part of the year 1888 Johnston determined to form a corporation for the purpose, among other things, of conducting and publishing said paper, and such corporation (the defendant The W. J. Johnston Company), was in fact, formed in January, 1889, with $250,000 of capital stock, all of which was issued to Johnston in exchange for property transferred by him to the company. The agreement referred to was made on the 26th of December, 1888. It was to go into effect on Jan. 1, 1889, and was terminable by either party at the end of any year upon a written notice of thirty days. Martin thereby agreed to undertake the editorship of the said Electrical World, and to devote his entire time and attention to the duties of that position and the interests of the contemplated W. J. Johnston Company at a yearly salary of $2,500. He further agreed to be diligent and faithful in the discharge of his said duties, and to do no act or thing whereby the business of the said W. J. Johnston Company should suffer any damage or loss while he continued to be so employed, and that he would not "lend or give his name for use to any electrical corporation or company as director, officer, trustee or otherwise," nor "purchase or hold any stock or certificates of stock in any electrical corporation, company or partnership, or become interested therein, without first obtaining the written consent of the party of the first part" (Johnston), nor, while in said employment, "devote any of his time or attention, during business hours or otherwise, in the interests or to the advantage of any other corporation, company, person, firm, electrical or otherwise, without the consent of the party of the first part, or of a majority of the directors of the W. J. Johnston Company." And it was expressly declared that these covenants, or some of them, on the part of Mr. Martin, were made "solely for the purpose of protecting the independence, reputation and standing of The Electrical World, as the connection in any way of an officer or employee of the W. J. Johnston Company with any other electrical corporation, company or partnership might seriously injure said 'Electrical World' and the business of the W. J. Johnston Company."

Upon his part the said Johnston agreed to transfer to Martin 100 shares of the capital stock of the said company, which should be retransferred by Martin to Johnston to be held in trust by him, and 20 of said shares should be surrendered to Martin at the end of each year of the continuance of the agreement; and Johnston further covenanted and agreed "that if, during the years 1889, 1890 and 1891 the dividends upon the said stock do not reach the sum of $2,500 per annum, he, the said Johnston, will make up to said Martin the deficiency upon the stock owned by him."

During 1889 the plaintiff performed his stipulated duties and received his salary from the company, and at the close of the year the defendant Johnston, as the agreement required, delivered to him 20 of the said shares of stock. He was also paid dividends for that year upon the 100 shares, amounting to $2,500. By this time differences had arisen between the two. The attitude of each toward the other was uncomfortable if not hostile. The plaintiff testifies that he was not at fault, and charges the defendant with improper interference with him in his editorial duties; with a denial of his rights as a stockholder and officer of the company, and with other unreasonable conduct. The defendant testifies that he was not at fault, and accuses the plaintiff of insolence, inattention to business and insubordination. Of course (it is always so), both parties were more or less to blame, but it is not necessary for me to determine which was the greater offender. There was serious trouble between them on the 7th of February, 1890, and on subsequent days, and on the 5th of March, after a rather spirited altercation, Martin received from Johnston the following letter of dismissal:

"Your services as editor of "The World" will not be required after to-day. If you have any personal belongings at the office please remove them this afternoon. The cashier will pay you on Saturday the amount due you for salary." This letter was either accompanied or swiftly followed by an intimation from Johnston that if the plaintiff did not retire peaceably he would be forcibly ejected. A formal tender of further services under the agreement was made by Martin and refused by Johnston. Thereupon Martin quietly accepted the situation, received from the company the salary due him, and very soon afterward entered the service of "The Electrical Engineer" as editor of that journal.

There is no direct testimony to that effect, but it is to be fairly inferred that Martin regarded his contract relations with Johnston as terminated by his discharge and by Johnston's refusal to permit him any longer to serve as editor of "The World." It may be safely said that no action like the present would have been instituted by the plaintiff had not the defendant on June 7, 1890, three months after the plaintiff's dismissal, written to the plaintiff as follows: "Please to take notice that I elect to terminate at the end of this year the contract between us dater Dec. 26, 1888." This the plaintiff insists was a distinct admission by the defendant that the said contract had not been terminated by anything that had gone before, but was still in force and would continue in force until the expiration of the time limited in the defendant's notice, and that it was also a waiver or any past default or breach of duty on the part of the plaintiff of which the defendant might have availed himself to terminate the contract. Both of these propositions may be admitted without removing or reducing the difficulty which, it seems to me, stands in the way of the plaintiff's recovery in this action.

It is a settled rule of law that neither party to a contract can enforce it against the other without showing performance or an offer or willingness and readiness to perform on his part. In May v. Schuyler, 11 J. T. S., 107, the court said: "Where the right to compensation depends upon a special contract the plaintiff must perform the undertaking assumed by him, and no matter what the terms and conditions may be upon which the right to compensation depends, they must be performed as a condition precedent to a right of action for the recovery of the specific compensation." This does not mean a literal performance in every particular detail. A substantial performance is all that is required. Woodward v. Fuller, 80 N. Y., 315. The same rule prevails in equity. A party who seeks to enforce a contract must show performance or its equivalent on his own part before he becomes entitled to relief. Pomeroy's Eq. Sect. 1407. Story's Eq. Sect. 771. Jones v. Lynds, 7 Paige, 346. Burling v. King, 66 Barb, 639. Crane v. Decamp, 6 C. E. Green, 414. Boone v. Missouri Iron Co., 17 Howard (U. S.) 343. Marble Co. v. Ripley, 10 Wall, 357. Stewart v. Raymond R. R. Co., 7 S. & M. 568. Watt v. Rogers, 2 Abb. Pr. 261. It is the duty of the court to inquire how far the reciprocal obligations of the party seeking relief have been fairly and fully performed. Story's Eq. Sect. 736. Crane v. Decamp, 6 C. E. Green,

414. "If the plaintiff's simple negative conduct, his neglect to do what he has undertaken to do, is sufficient to prevent his obtaining the remedy of specific performance, much more does the same result follow from his affirmative acts which are in direct violation of the contract." Pomeroy's Eq. Sect. 354.

Whatever the plaintiff was entitled to receive under the agreement of Dec. 26, whether salary, stock or dividends, was in the way of compensation for the services which he engaged to render. His right to demand salary, stock or dividends was conditional upon his performance of the duties and his observance of the covenants assumed by him by that agreement. That the defendant had the right to rescind the agreement for sufficient cause is not disputed. Neither is it disputed that on the 5th of March he assumed or attempted to exercise that right. Whether the defendant's action on that day in notifying the plaintiff that his services as editor of "The World" were no longer required, and his subsequent action in refusing to accept further services from the plaintiff, were justified by any misconduct or default on the part of the plaintiff, has been a matter of prolonged and vigorous contention between the parties before me. In the view which I take of the case it is not material whether the plaintiff was rightfully discharged, or whether the defendant's notice of June 7 operated to prolong the agreement of Dec. 26 until the expiration of 1890. I shall assume that the agreement was in force during the whole of the last mentioned year, and that each party continued bound to the other according to its terms.

Here may be mentioned another well settled rule of law. When one party to a contract refuses or fails to perform, it is the duty of the other party so to act that the damages to the defaulting party shall be made as light as possible. Johnston v. Meeker, 96 N. Y. 97. But a servant, wrongfully discharged, is bound only to use reasonable diligence to procure other employment, and he is not required to accept employment of a different character, or employment of any kind in a different locality. Costigan v. Mohawk & Hudson Co. 2 Denio, 609. Fuchs v. Koerner, 107 N. Y. 529. The contract of service remains in full force in his favor although broken by his employer, and his remedy is to treat it as continuing and sue for damages for the breach. Howard v. Daly 61 N. Y. 369. Weed v. Burt, 78 N. Y. 193. In computing his damages account will be taken of wages received by him from other employment after his dismissal and down to the expiration of the contract, or of wages that he might have earned in similar employment offered to him and refused, or which he might have obtained by the exercise of reasonable diligence. Costigan v. Mohawk & Hudson Co. 2 Denio, 616. But the agreement between master and servant may be much more than a mere promise by one to pay a stipulated sum for services promised by the other; and although the servant may be wrongfully discharged, he may not be thereby released from the observance of covenants or conditions in the agreement contained, and may forfeit his right to damages by his own violation of the agreement upon which he founds his action against his employer.

Mention has already been made of the provisions of the contract in question, by which the plaintiff bound himself during the continuance thereof to do no act or thing whereby the business of the W. J. Johnston Company should suffer any damage or loss directly or indirectly, and not to lend or give his name for use to any electrical corporation or company, or to become interested, as stockholder or otherwise, in any electrical corporation, company or partnership, and of the express declaration of the contract that such provisions were made "solely for the purpose of protecting the independence, reputation and standing of The Electrical World, as the connection in any way of an officer or employee of the W. J. Johnston Company with any other electrical corporation, company or partnership might seriously injure said The Electrical World and the business of the W. J. Johnston Company." It appears from the proofs that within about ten days from the date of his dismissal by the defendant the plaintiff entered the employment of a corporation called "The Electrical Engineer;" that about April 1 he became the editor of a paper published by said corporation and bearing the same title; that he has ever since remained in such employment and so employed; and that he is also a stockholder in said corporation, although the date of his becoming such has not been shown. It further appears that "The Electrical Engineer" is a rival paper to The Electrical World, occupying the same field and competing with The Electrical World for support from the same source and same class of patrons. This brings into a clear light the question whether the plaintiff has so kept his agreement with the defendant that he has a right to require of the defendant a strict performance upon his part. Has he so done equity that he has a right to ask it?

It seems to me that the wrongful discharge, if it was wrongful, of the plaintiff did not relieve him from his engagement not to become interested in or identified with a competing electrical corporation or company. He cannot insist that his agreement with Johnston remained in force as to Johnston's covenants, but was no longer obligatory upon himself. He cannot excuse his entering the service of a rival corporation by the plea that the law required that he should do what he could to reduce the defendant's loss, because the defendant, by the agreement, had prohibited him from entering such service. I cannot see upon what ground the plaintiff can come into a court of equity, alleging that this agreement was in force until the close of 1890, and claim a specific performance of it by the defendant, when it appears by undisputed testimony that he, the plaintiff, from about the date of his dismissal to the end of the year, was disregarding his own agreements and engaged in aiding and building up an enterprise which was rival, if not hostile, to the W. J. Johnston Company.

A decree for a specific performance is never a matter of right. It rests in judicial discretion and may be granted or withheld upon a consideration of all the circumstances. Miles v. D. F. I. Co., 125 N. Y., 297. Margraf v. Muir, 57 N. Y., 158. Burling v. King, 2 T. & C., 545. Gale v. Gale, 42 Barb. 320. Martin v. Platt, 5 State Rep., 290. Marble Co. v. Ripley, 10 Wallace, 357. That discretion should never be exercised in favor of a plaintiff who "has so conducted himself as to destroy all claim to its interposition." St. John v. Benedict, 6 J. Ch., 111.

For reasons stated above the defendant is entitled to judgment dismissing the complaint.

Enamel Rheostats, Electrical Heaters and Cooking Utensils.

The enameling process of applying resistance wires to metallic surfaces has fairly opened up a wide field of electrical development, particularly in electrical heating and cooking apparatus, and offered the means for a most notable improvement in the construction of rheostats. Mr. George Cutter, of Chicago, with his accustomed foresight, has secured control of fundamental patents relating to the enameling process, and his licensees for the manufacture, the Enamel Electric Manufacturing Company of New Jersey, have installed a very complete plant at the new electrical town of Ampere, N. J., where a complete line of rheostats, cooking utensils and heaters will be manufactured for Mr. Cutter, who will handle the entire product.

In the process used by Mr. Cutter the resistance wires are coiled on the enameled surface of steel tubes and then covered with another coat of enamel and baked, the copper end connections being the only parts not absolutely protected from accidental contact and the atmosphere by the coating of enamel. Several standard sizes of tubing are used, and the various apparatus constructed by disposing these in a manner most suitable for the end in view. Different resistance wires are used, copper wire being employed for large currents.

At present but two of the six baking furnaces are sufficiently advanced to be used, and these are now being being busily employed in the manufacture of an exhibit for the World's Fair, and in an attempt to fill the large number of orders for rheostats that are coming in, one of which is for 5,000 complete rheostats.

At present the ordinary metal rheostat box with slate face is used, the coils of resistance wire being replaced by the enamel tubes. The space occupied by the latter, however, is much smaller, a ½-h. p. ordinary rheostat case being used for a 2-h. p. enamel rheostat. Among the first who have availed themselves of the superior advantages of the new rheostat is the Crocker-Wheeler Company, which will use them exclusively on its dynamos and motors as well as with the extensive line of electric machine tools soon to be placed on the market.

A form of heater being manufactured consists of a perforated metal cylinder, handsomely enameled in colors on the exterior and with the enameled resistance tubes arranged inside, the result being very effective and at the same time artistic.

In manufacturing cooking utensils the heating tubes will be assembled in a base frame and with no necessary connection with the utensil itself. The advantage of this method is obvious. The wires will not only be less subject to damage, but the convenience in handling will be much greater. When necessary through wear or an accident to replace a utensil the expense will be a mere fraction of what it would were the heating arrangement a component part of it.

As soon as the works are entirely completed and some of the heavy orders for rheostats worked off a full line of apparatus will be placed on the market. As particular attention will be paid to extending the application of the process we may expect under Mr. Cutter's well known enterprising direction to see many novel uses developed.

The New Town of Ampere.

A promising commencement of a town, with one of the fathers of electricity as its tutelary genius, has been made in New Jersey, and the indications are that it will prove worthy of the great name it bears.

Ampère is on the line of the Delaware, Lackawanna & Western Railroad, about a half-mile from Roseville, and a mile from Newark. The many manufacturing towns and villages in its immediate vicinity furnish a labor market for its present needs, but its desirability as a residence place on account of its situation will undoubtedly attract a large population of its own.

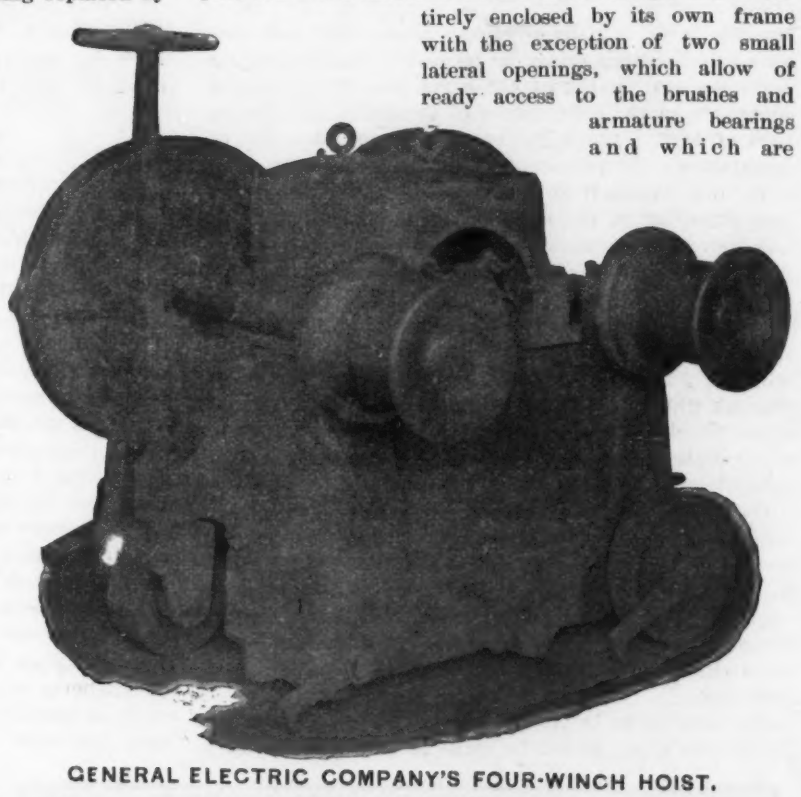
At present the great establishment of the Crocker-Wheeler Electric Company, the electric enameling works of George Cutter, and a pretty railway station are the only buildings on the site. As soon as these are completed, however, a boom in town building may be expected, and the combined attractions of the name, its good situation in regard to labor markets and transportation and as a desirable residence place should result in an expansion to a great electrical centre.

The Crocker-Wheeler company have purchased six acres of land, and extensive buildings in which they will carry on their manufacturing are being fitted up for that purpose in the same thorough manner that characterizes this company in every thing it undertakes. Every detail has apparently been thoroughly worked out so that when finished the manufactory will be, it is not too much to say, one of the best appointed in the world. Shafting is entirely dispensed with, electric circuits of copper rods taking their place, which are tapped at intervals to supply the motors with which each machine is separately furnished. In this respect the plant will serve as a useful model and undoubtedly accelerate the adoption of this method of power distribution.

General Electric Company's Four-Winch Hoist.

The four-winch hoist for use on wharfs and on vessels is the latest device of this character which the General Electric Company has perfected. It has been designed to meet a growing demand for apparatus which will satisfy the varied requirements of ship and dock work, and it offers special advantages to which the steam hoist cannot lay claim. It is more compact, less weighty, and does not require the special attention of a trained engineer. It can be used in cold weather without the waste of power attendant upon the use of steam by great steam condensation, and there are no burst or leaking pipes connected to it as with hydraulic hoisting apparatus. For use on shipboard the winch head hoist is more convenient than the drum hoist, as it is better adapted to the variety of hauling and hoisting incident to the manipulation of a ship's cargo. A number of loads may be raised or lowered simultaneously, each winch head being independent of the others.

The apparatus illustrated consists of a base frame, a motor, two shafts, each carrying two winch heads, and the necessary controlling apparatus. The frame is a strong cast iron box open at top and bottom, and supporting on its upper rim the motor and winch shaft bearings, each furnished with self-oiling mechanism. The frame is provided with wheels for convenience of application. The motor is of the latest design and is entirely enclosed by its own frame with the exception of two small lateral openings, which allow of ready access to the brushes and armature bearings and which are closed when the hoist is in operation. It is so set in the hoist frame as to secure a low centre of gravity and great rigidity. The field coil of the motor and winding of the iron clad armature are covered with special waterproof composition.



GENERAL ELECTRIC COMPANY'S FOUR-WINCH HOIST.

The winch shafts are of large diameter steel rod, to obviate the possibility of bending under heavy loads. The winch heads are keyed to the shafts over bronze bushings, and the difficulties which rust might create forestalled. Each winch is provided with two safety pawls, which, when the hoist is in operation, are held out of action by centrifugal force, but which immediately catch into notches provided in the bearing cap, if the current fail while a load is being hoisted. This prevents overhauling of the hoist by the load, which might otherwise happen with disastrous results. The apparatus for controlling the hoist is placed below the motor within the frame, where it is protected from mechanical injury and moisture.

The particulars and dimensions of this hoist are as follows:

Net horse power of hoist at winches	45 h. p.
Normal speed of motor	425 revolutions
Voltage of motor, according to order	110, 220, 500 volts
Current at 110 volts	360 ampères
Total weight of hoist, complete	8,000 pounds
Lifting capacity of hoist—2 weights simultaneously	3,000 pounds
Speed of lifting	250 feet per minute
Diameter of winch heads	12 inches
Length of winding space on winch heads	9⅛ inches

Over-all dimensions of hoist are as follows:

Length	6 feet 10 inches
Width	6 feet 7 inches
Height with wheels	4 feet 7⅛ inches
Height without wheels	4 feet 5⅛ inches

The New Standard Kennelly Ammeter.

This instrument, manufactured by the Edison Manufacturing Company, of 110 East Twenty-third street, New York City, consists of a flat horseshoe magnet with its poles brought out into semi-circles facing each other and

separated by about 1-16th of an inch. This large polar surface and narrow air gap make a magnetic circuit very nearly closed. It is well known that a solid anchor ring of steel uniformly magnetized round its circumference has no demagnetizing force, and therefore no tendency to alter its magnetization. In the narrow space between the semi-circular pole faces is pivoted a disc armature, as shown in the accompanying illustration, the plane of the disc being parallel to the polar surfaces and midway between them. Starting from the centre, the insulated wires forming the armature winding are laid radially and symmetrically over the upper surface of the disc, the accuracy of angular spacing being mechanically preserved. One-half of the disc is completely covered by the pole faces, and the other half projects beyond them. Two spiral springs bring the measured current into and from the disc, acting at the same time as a restoring couple, as in the instruments of Cauderay and Gimingham of 1886. When the current passes through the armature an electromagnetic pull is set up in the plane of the disc, urging it to right handed or left handed rotation according to the direction of the current. As the disc moves in obedience to this force as many radial wires enter the poles on one side as leave them on the other, so that the electromagnetic force corresponding to the current strength remains uniform, while the retractive force from the spiral springs increases directly with the angle of displacement. In this way the angle through which the disc and its attached pointer move is proportional to the current strength, and the graduations of the scale are nearly uniform. The scale itself is wide, and covers an arc of about 125 degrees.

The shaft bearing the disc is pivoted on agates to reduce friction, and the whole armature complete only weighs a few grammes, so that it is not liable to be damaged in transport. The instrument will register in any position, but is most sensitive when testing horizontally. The total absence of iron from the armature insures freedom from rysteresis or magnetic lag.

The instrument is very light, weighing six pounds in its wooden case. It can be made in any capacity up to 100 amperes. It is not affected by the earth's magnetic force nor even by the stray field from dynamos beyond a few feet radius. Its resistance and inductance are very low. Its frame is very strong and compact, being supported entirely on the magnet, which is again secured to the base with the intervention of soft rubber washers.

The meters are all adjusted and standardized at the Edison laboratory, by comparison with the standards there maintained. The scales are read off over mirrors to avoid parallax, and the movements of the needle are practically deadbeat.

No instrument of its type has yet made its appearance in which the magnetic circuit is so nearly closed, and this is the special advantage of the disc armature form.

The binding posts are large and strong. The case is handsome, and the workmanship of the highest grade.

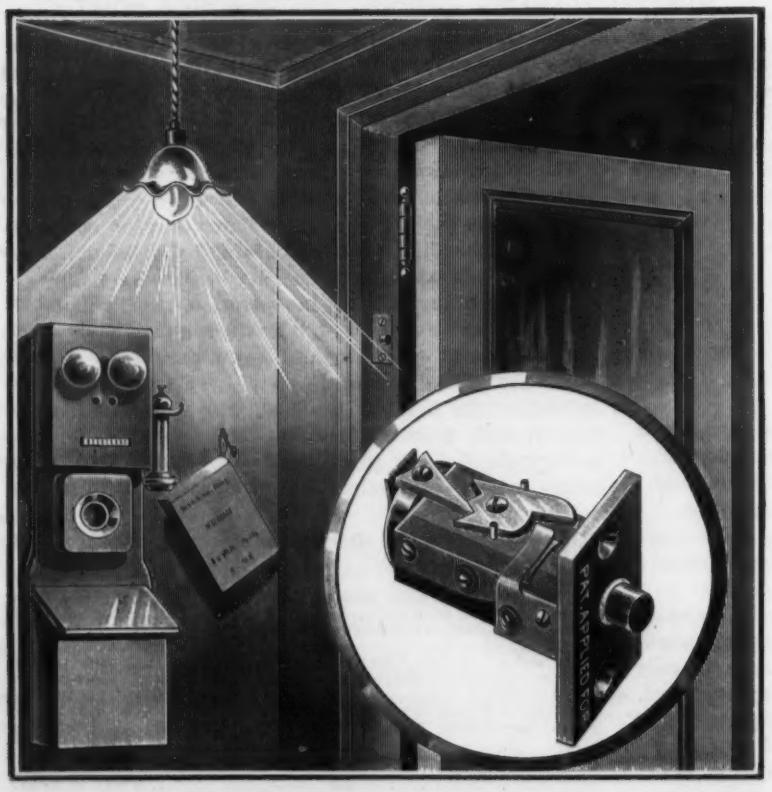
A considerable advantage possessed by this form of ammeter is its independence of the distribution in magnetic flux through the armature. In this instrument, however, the winding is spread uniformly over the surface of the disc armature, which is only partly covered by the field, and consequently no movement of the armature within the range of indication can alter the relation between winding and magnetic field, however irregular the latter may be.

THE NEW STANDARD KENNELLY AMMETER.

A Novel Electric Switch.

One of the striking advantages of the electric light over gas is the great inconvenience resulting from its use in turning a light on and off. The switch illustrated, which is manufactured by the New York Improvement and Electrical Development Company, 251 William street, N. Y., adds to this advantage in being automatic in its action. The switch is mortised flush in the jam of a door, and is operated by the opening and closing of the same, turning on the light upon entering the room and turning it off when the door is closed on leaving.

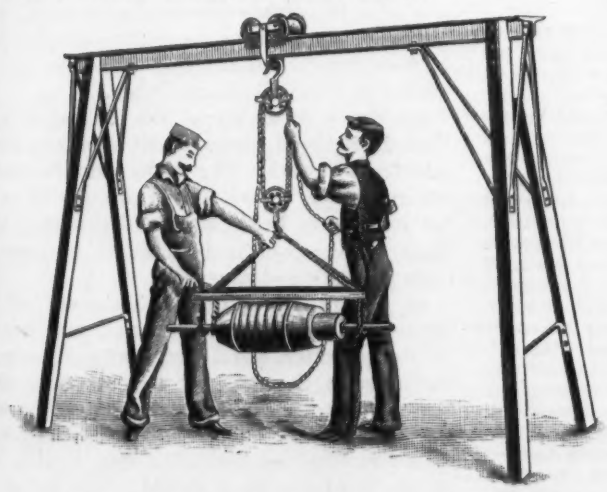
The mechanism is simple and consists of two pivoted pieces and flat spring attached to the usual push form of a door burglar alarm. When the door is opened the spring behind the push forces it out and the pawl pivoted on the end enters one of the two teeth of the contact piece of the switch, which is forced between two springs, thus completing the electric lamp circuit. When the door is then closed the pawl is disengaged and the flat spring on its head brings it in a central position, where it is ready to enter the other tooth; when the door is opened on leaving the room the pawl descends into this tooth, disengaging the contact piece and thus breaking the circuit. When the door is then closed the pawl is in position to again turn on the light.



A NOVEL ELECTRIC SWITCH.

The Brown Electric Company's Portable Crane.

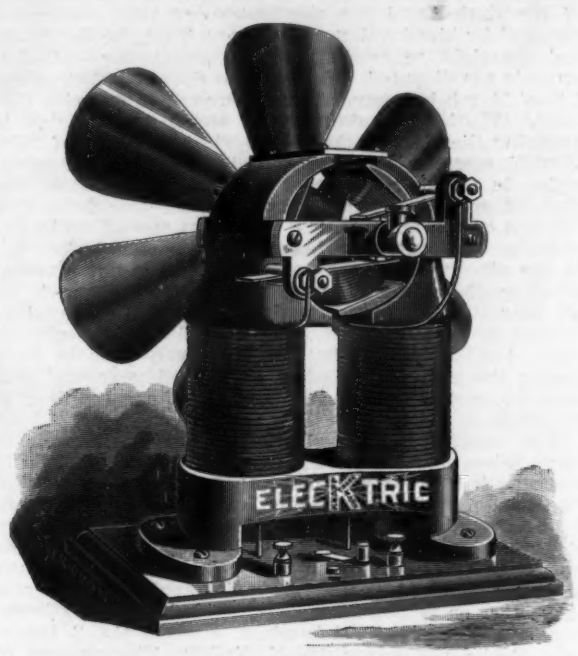
A most useful adjunct of electric light and power stations has just been placed upon the market by the Brown Electric Company, of Boston, Mass., in the form of a portable crane with roller attachment, which is shown in the accompanying illustration. With this piece of apparatus armatures and fields or other heavy machinery can be easily and safely handled. This crane is 12 feet long and 8 feet high. It is strongly built and very durable. It will, no doubt, find its way into a great many of the stations throughout the country where the absence of such a piece of machinery is now strongly felt.



THE BROWN ELECTRIC CO.'S PORTABLE CRANE.

The Knapp Electric Motor, No. 3.

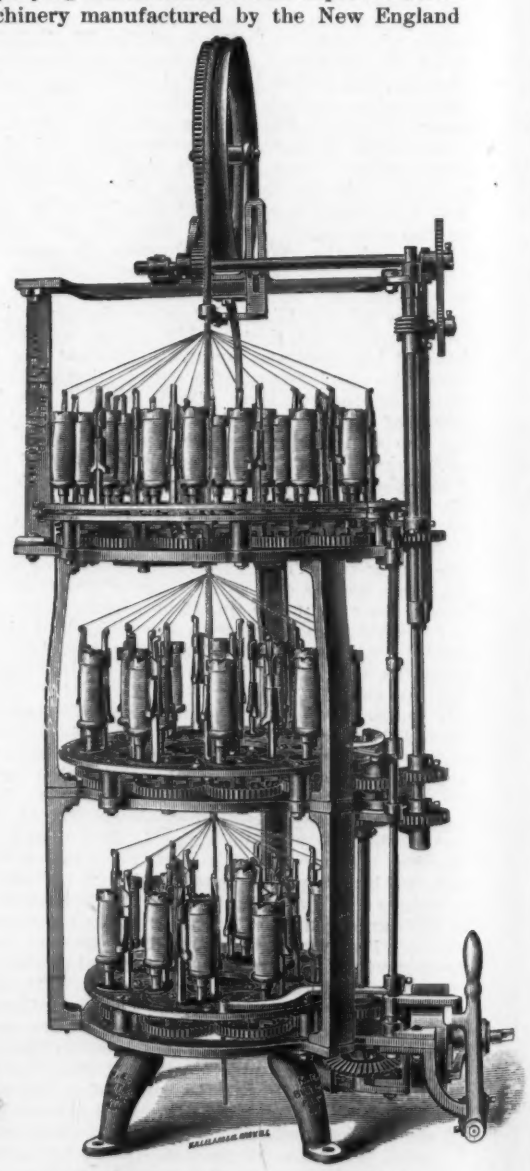
The motor which is shown in the accompanying illustration, and which is manufactured by the Knapp Electric and Novelty Company, 34 Warren street, New York City, has a number of new features which will undoubtedly attract attention. Its small weight, which is only 12 pounds, and its compactness, the total height being but eight inches, commend it, and in construction and workmanship it has been brought up to the standard of much higher priced machines. It is intended to run on from 4 to 10 volts. For fan work a good rate of speed can be attained on four volts. Any storage battery, of course, may be used, or any primary battery giving a current consistent with the work required. It is adapted not only for running a fan but for driving light machinery, such as small lathes, etc. When operating as a fan it is equipped with a 10-inch fan having six blades, and a fan guard.



THE KNAPP ELECTRIC MOTOR NO. 3.

An Improved Triple Braider.

The accompanying illustration shows an improvement in braiding machinery manufactured by the New England Butt Company, of Providence, R. I. This machine is a large gear braider made in triple form, of size 16 × 20 × 24 strands. These machines are made with iron scored rolls and for covering telephone and electric wires have been found to operate with great success. They are strongly and compactly made, and the very best of material and workmanship are employed.



IMPROVED TRIPLE BRAIDER.

Financial Intelligence.

First Annual Report of the General Electric Company.—The first annual report to the stockholders of the General Electric Company was presented by President C. A. Coffin at the meeting on April 11, 1893, and is as follows:

The General Electric Company was incorporated April 15, 1892, and began active business on the first day of June, 1892; so that the report presented by your directors, at this meeting of stockholders, covers a period of eight months ending Jan. 31, 1893.

As you know, the General Electric Company acquired, in exchange for its stock, practically all the capital stock of the Edison General Electric Company, of the Thomson-Houston Electric Company, and of the Thomson-Houston International Electric Company. These three corporations, referred to hereafter in this report as the underlying companies, still retain their independent corporate existence. The first two continue their manufacturing business as before, the General Electric Company purchasing and distributing the chief part of the apparatus manufactured by them. The various selling and many other departments of the Edison General and Thomson-Houston companies have been gradually merged into corresponding organizations of your company.

The difficulties inherent in such a reorganization were many and serious, and we feel that the stockholders are to be congratulated that, largely because of the zeal and hearty co-operation of the former officers and employés of the Edison General and Thomson-Houston companies, it has been carried through to a complete and successful issue.

LOCAL LIGHTING AND RAILWAY COMPANIES.

While your company has about 6.000 customers included in the different departments of its business, the interesting and important development is in the direction of local lighting and railway enterprises.

The following information, with respect to local illuminating and electric street railway companies using your apparatus, will be of interest to the stockholders.

Lighting Companies.

The total number of such central station companies using Edison and Thomson-Houston apparatus is 1,277, supplying about 2,500,000 incandescent and about 110,000 arc lamps.

The growth of these companies has been phenomenal, and it is very satisfactory to note that those which have been established longest are making the most rapid increase in size of plant and volume of business.

During the past year there has been a very marked appreciation in the value of the securities of local companies, especially in the large cities, testifying to the increased confidence of investors in such properties.

Railway Companies.

	Feb. 1, 1891.	1892.	1893.
Total number of roads operating and under contract	151	214	435
Total number of cars in actual operation	1,578	2,790	8,386
Number of miles of road in actual operation	1,252	2,315	4,927

During the past eight months there has been a notable increase in the size of individual machines manufactured at the different factories, as well as a large increase in the total factory output.

On Feb. 1, 1892, the largest power generator manufactured was of 275 h. p. Machines of 2,000 h. p. each are now being manufactured by your company, seven of which are already sold for early delivery. The largest lighting generators in use Feb. 1, 1892, were capable of supplying only 2,000 incandescent lights each. There are now being constructed generators of the direct-coupled type with a capacity of 12,000 incandescent lights each. Many local lighting stations are being equipped with steam engines directly coupled to such machines, giving a capacity of about 25,000 incandescent lights from each engine.

Of the largest direct-coupled lighting generators which were manufactured a year ago there were shipped during the year 1892 an aggregate of 7,000 h. p. Of such sizes now being constructed, there are at present on order 8,000 h. p.

Machines for power purposes (principally railway) aggregating 40,000 h. p. have been shipped during the past year. There are now being manufactured, on order, generators aggregating 37,000 h. p., or practically as much as the total shipments for the past year.

Most satisfactory progress has been made in the development of apparatus for mining purposes, particularly of locomotives for haulage work in coal mines. Thirty of such locomotives, with a very large amount of other mining material, are now under construction at the works.

The efforts of many of your best engineers have been directed for some time to the production of electric locomotives, for which we now have numerous orders for haulage and general railway purposes. Two locomotives of 1,000 h. p. each, ordered by one of the principal trunk lines, are now under construction and nearly ready for use. The equipment of the elevated electric railway at the World's Fair, six miles in length, and which is now nearly completed, is being supplied from the Schenectady factory, and it is hoped will be in operation at the opening of the Fair.

LICENSEES.

The relations between your company and its various licensees, and between it and those of the underlying companies, are of the most satisfactory character. Your directors appreciate that the interests of the company are closely connected with the welfare of its licensees, and there is a corresponding recognition on the licensees' part that the cordial co-operation of your company is essential to the fullest development of their business.

No effort will be spared to secure from the recent patent decisions in your favor the greatest possible benefit to these licensees. The public through them will be distinctly benefited, because of the concentration of local illuminating and power business in the licensed central stations equipped for supplying light and power at minimum rates.

The prices at which apparatus and lamps are now furnished by the General Electric Company, for use of such stations, are in many instances lower than those which prevailed prior to sustaining the lamp patent, while the quality and efficiency of the apparatus are largely increased. Thus the licensees are enabled to cheapen their production and their prosperity is greatly enhanced—a prosperity in which your company has a direct and permanent share.

PATENTS.

The patent situation is encouraging and promising. The decision of the highest court sustaining the fundamental incandescent lamp patent, which decision has been followed by many other tribunals, has vested in your company the right to the incandescent lamp business of the United States, a result of great value to the company.

The strenuous efforts made by your competitors to develop an incandescent lamp which will not infringe this patent have been thus far wholly without success, and there is no reason to believe that any different results will be achieved in the future.

The decisions heretofore rendered in favor of the Thomson-Houston and Brush companies, covering the double carbon arc lamp, automatic current regulation and electric storage, are of very great value to your company.

Although it is well known that the patented inventions of Edison, Thomson, Brush, Van Depoele, Rice, Sprague, Bentley, Knight and other inventors now or heretofore connected with your organization are the basis of substantially the entire arts of electric lighting, electric railways and electric motive power now in general use, the situation up to the date of the organization of the General Electric Company was not favorable to the best development of business under these inventions.

Suits against infringers are now in active progress on many important patents, other than those already sustained by the courts, covering essential features in electric railway, lighting and power apparatus. These suits will be pushed as vigorously as possible.

In dealing with the numerous past infringers your directors are of the opinion that the substantial interests of the shareholders can be protected without a harsh or offensive exercise of your rights, and in such a way as to greatly benefit the company and to satisfy consumers and the public of its desire to act in an entirely fair and liberal spirit.

FINANCIAL.

There are annexed to this report the company's condensed balance sheet and statement of profit and loss as of Jan. 31, 1893, showing that in the eight months during which your company has been in operation its profits amount to $1,024,954.59 in excess of three quarterly dividends on the common and one semi-annual dividend on the preferred stock.

In order that the stockholders may understand the position of the company, the following explanation as to the general character of the items in the balance sheet is submitted:

Investment Accounts.

Under this head will be found the assets now represented by the stocks of the three underlying companies, substantially all of which have been acquired by your company.

Details in regard to these companies will be found herewith from which it will be noticed that the basis upon which they were acquired by your company represents a cost of about $8,000,000 for all their patents, other valuable rights, licenses and other contracts. This is after writing down the assets they still own—manufacturing plants, factory inventories, etc.—to conservative valuations.

The transactions of your company are to a considerable degree with local companies working under contracts licensing them to use the patents, about 2,000 in number, under which your company operates. Your company is now supplying apparatus to about thirteen hundred local companies, the royalties from which run from $1,500,000 to $2,000,000 per year. It is believed that the royalties will be greatly increased in the future, so that $8,000,000 would appear to be far within the actual value of the patents, contracts, etc., which are represented thereby.

Your company has to a large degree acquired the business, other than manufacturing, of the Thomson-Houston and Edison General companies, and has liquidated a large part of their liabilities. This course will be continued during the present year.

The preferred stock of the United Electric Securities Company has been sold since the close of the fiscal year at a price in excess of the value at which it appears in the balance sheet. The common stock of the same company—$825,500 out of a total issue of $1,000,000—is taken in the balance sheet at par. The company is making large profits and paying regular quarterly dividends.

The stock of the Canadian General Electric Company, a manufacturing and selling company controlling the Edison and Thomson-Houston patents in Canada, is taken at par. Its sale at an early date is expected, it being now under option to a Canadian syndicate at above par.

The stocks of the Fort Wayne Electric Company and Northwest General Electric Company are paying 8 per cent. dividends on the value at which they stand in the balance sheet.

Stocks of "miscellaneous companies," carried at $71,566, comprise holdings in various corporations not considered local or licensee companies.

Other Assets.

With reference to these items it may be stated that in the judgment of your board they are taken at safe figures. They consist of stocks, bonds, cash, notes and accounts receivable, merchandise on hand and work in progress; and it will be noticed that they amount to $29,559,600.61 as against total current liabilities of $5,246,219.

The stocks of local companies, which appear in the balance sheet at $5 772.622.80 (par $11,362,011.65), have been valued carefully with the intent to carry them at a figure which can easily be obtained for them.* As a further margin in this respect, stocks amounting at par to $1,301,940 (most of which accrued to this company under license contracts with recently organized companies) are taken in the balance sheet at the nominal value of $1 for each block, although there is reason to believe that within a moderate time these will develop a substantial earning capacity.

The bonds are almost entirely those of local companies. They are nearly all first mortgage bonds, payable in gold, and stand in the balance sheet at about 70 per cent. of their face value. All of these bonds excepting $439,000 at par value—$251,088.07 book value—are regularly paying their interest, and the comparatively small amount in default is carried at prices lower than it is believed will be realized.

Some of the bonds carried in the balance sheet have been sold since the close of the fiscal year at prices in excess of their book value, and the rest will be sold from time to time through the United Electric Securities Company and other channels as heretofore.

The amount now accruing to your company as dividends (exclusive of those received on the stocks of the underlying companies) and as interest, from its holdings of stocks and bonds shown in the balance sheet, exceeds the amount required to pay interest on your company's $10,000,000 outstanding debenture bonds.

After careful examination, deductions have been made from the notes and accounts receivable to cover fully all bad and doubtful items.

The item "inventories" represents all the company's stock of apparatus, material, machinery, fixtures, etc., in the offices and storehouses of your company's seven districts, and includes the machinery, tools and material in the various repair shops connected with such district offices.

"Work in progress" represents the annual cost to date of all labor, material, etc., on unfinished contracts now in course, which, when completed, will afford a considerable profit.

The cost of patents acquired by your company during the eight months has been charged off as an operating expense.

Contingent Liabilities.

Your company makes a practice of indorsing and discounting some of the notes it takes from its customers. Such indorsed notes are not included in notes receivable in the balance sheet, where only those now held by your company are taken into account. The outstanding notes receivable which had been indorsed and discounted on Jan. 31, 1893, amounted to $3,787,312.63.

C. A. COFFIN, President.

UNDERLYING COMPANIES.

Edison General Electric Company.

The cost of acquiring 149,699 shares of the capital stock of the Edison General Electric Company was		$14,969,900.00
Less net amount credited to that company, after charging it with money advanced, and with an arbitrary amount of $695,000 as a guarantee against its customers' notes and accounts transferred to the General Electric Company, and after crediting it with sundry assets taken over by this company		6,336,691.54
Making present cost, as shown on the balance sheet		$8,633 208.46
This amount represents the following:		
Manufacturing plants, being the investment in lands, buildings, machinery and tools at Schenectady, N. Y., and Harrison, N. J.	$2,677,548.09	
Machinery and materials sold to United States Wire and Cable Company, but not yet paid for	282,147.76	
†Schenectady and Harrison factory inventories	2,576,887.14	
Cash and notes and accounts receivable.	409,117.86	
Total	$5,945,700.85	
Less debt	1,551,660.71	
		4,394,040.14
Leaving		$4,239,168.32

represented by patents which have cost the Edison company about $2,000,000, and by holdings of the entire capital stocks of Edison underlying patent-owning companies, under contracts with which all large Edison licensees give to the Edison company a percentage of their entire issue of stocks and bonds.

Thomson-Houston Electric Co.

The cost of acquiring 399,347 shares of the capital stock of the Thomson-Houston Electric Company was		$18,381.970. 00
Less net amount credited to that company, after charging it with money advanced, and with an arbitrary amount of $1,000,000.00 as a guarantee against its customers' notes and accounts transferred to the General Electric Co., and after crediting it with sundry assets taken over by this company		9,935,118. 22
Making present cost, as shown on the balance sheet		$8,416,851. 78
This amount represents the following:		
Manufacturing plant, being the investment in lands, buildings, machinery and tools at Lynn, Mass	$1,240,063. 77	
†Lynn factory inventory	2,263,347. 59	
Cash and notes and accounts receivable.	428 126. 91	
Raw copper	135,515. 94	
Consignments	8,396. 71	

*Included in this amount are shares of the Edison Electric Illuminating companies of New York, Boston, Brooklyn, Philadelphia and Chicago of a par value of $2,625,300. The present market value of these stocks is in excess of $3,400,000, although taken in the balance sheet at $3,024,695. Besides these there have been acquired, in the usual course of business, shares of one hundred and thirty-seven other companies, a large part of which will probably be disposed of through the ordinary channels.

† Raw materials, materials in process of manufacture with labor thereon added, and finished apparatus in stock, ascertained by actual inventories figured on liquidating values, i. e., raw material at *present* cost prices, apparatus finished and in process of manufacture at cost of labor and material, and obsolete apparatus at "scrap" value.

Stocks of the Brush, Excelsior, Ft. Wayne and Schuyler Electric companies, and stocks of other manufacturing and patent owning companies (par value $7,312,980) carried at	$4,013,420.11		
Stocks of the Cent'l Thomson-Houston, Eastern Electric Construction, Northwest General Electric, Thomson-Houston Electric Light and Thomson-Houston Motor companies (par value $1,468,350) carried at	891,750.00		
	$4,905,170.11		
Liquidation value, say		$2,500,000 00	
		$6,575,463.92	
Less debt		1,517,964.21	
			5,027,499.71
Leaving			$3,389,352.07

represented by patents, including Brush patents on double carbon arc lamps, storage batteries and patents on current regulation, all of which have been sustained in the U. S. Courts, and by about 1,400 other patents owned by the Thomson-Houston Company, and manufacturing companies controlled by it.

Thomson-Houston International Electric Company.

The entire capital stock of the Thomson-Houston International Electric Company was acquired at a cost, as shown on the balance sheet, of			$1,212,000.00
This amount represents the following:			
Stock of other companies		$13,139 00	
Cash, and notes and accounts receivable..		468,076.02	
Charges against its branch offices		468,944.69	
Inventory and consignments		39,049.98	
		$989,209.69	
Less debt		307,953 32	
			$681,256.37
Leaving			$530,743.63

represented by the rights in foreign countries under patents of Thomson, Rice and others, including contracts for delivery of $100,000 stock of the Canadian General Electric Company, and substantial interests in other manufacturing and exploiting organizations in foreign countries.

CONDENSED BALANCE SHEET, JAN. 31, 1893.

ASSETS.

Investment Accounts.

Stock of underlying companies:			
Thomson-Houston Electric Company	$8,416,851.78		
Edison General Electric Company	8,633,208.46		
Thomson-Houston International Electric Company	1,212,000.00		
			$18,262,060.24
Real estate:			
Edison Building, New York City	$410,804.62		
Less mortgage thereon	200,000.00		
	$210,804.62		
Other real estate	87,922.12		
		298,726.74	
Stock of United Electric Securities Company:			
Preferred (par, $454,300)	$408,870.00		
Common (par, $825,500)	825,500.00		
		1,234,370.00	
Stocks of manufacturing and other companies:			
Canadian General Electric Company (par, $1,000,000).	$1,000,000.00		
Excelsior Electric Company (par, $5,000)	1,300.00		
Ft. Wayne Electric Company (par, $704,700)	352,350.00		
Northwest General Electric Company (par, $155,000)	155,000.00		
Miscellaneous companies (par, $481,033)	71,566.00	1,580,216.00	
			$21,375,372.98

Other Assets.

Stocks and bonds of local companies:			
Stocks (par, $11,362,011.65)	$5,772,622.80		
Bonds (par, $4,858,380 00.	3,400,629.07	$9,173,251.87	
Cash	$3,871,033.58		
Notes receivable	5,151,950.64		
Accounts receivable	7,078,879.15		
		16,101,863.37	
Inventories	$2,307.225.13		
Less 10 per cent	230,722.51		
		2,076,502.62	
Work in progress		2,207,982.75	$29,559,600.61
			$50,934,973.59

LIABILITIES.

Capital stock:			
Common	$30,426,900.00		
Preferred	4,236,900.00		
		$34,663,800.00	
Five per cent. gold coupon debenture bonds		10,000,000.00	

Other Liabilities.

Accrued interest on debenture bonds	$83,333.32		
Dividends declared but unpaid	608,538 00		
Notes and accounts payable..	4,554,347.68		
		$5,246,219.00	
Surplus Jan. 31, 1893		1,024,954.59	
		$50,934,973.59	

STATEMENT OF PROFIT AND LOSS, JAN. 31, 1893.

EXPENSES.

Interest and discount	$89,513.42
Interest on debenture bonds	152,917.17
Dividends paid and dividends declared, but not yet paid	1,971,056.50
Patents, now charged off	118,151.42
Surplus carried forward	1,0 4,954.59
	$3.356,593.10

EARNINGS.

Net profits from the business of the eight months over and above all expenses, deductions for bad debts, etc.	$3,356,593.10
	$3,356,593.10

Electrical Stocks.—The following are the closing quotations for electrical stocks, Saturday, April 15, 1893:

	Par.	Bid.	Asked.
Brush, Ill., New York	50	25	30
East River El. Light	100	....	65
Electric Con & Supply Co. pref	15	15	16
Electric Con. & Supply Co Com	15	15	17½
Edison Elec. Ill., New York	100	124½	125½
Edison Elec. Ists		121½	122
Edison Elec. Ill., Brooklyn	100	108	110
Edison Elec. Ill., Boston	100	140	160
Edison Elec. Ill., Chicago	100	220	230
Edison Elec. Ill., Philadelphia	100	140	160
Edison Elec. Lt. of Europe		2	6
Edison bonds		80	85
Edison Ore Milling		5	12
Fort Wayne Electric		121½	123¾
General Electric Co	100	105½	105¾
General Electric deb. 5s		99¾	100
Interior Conduit and Ins. Co	100	62	65
Mount Morris Electric		....	65
Westinghouse Consolidated	50	36	37
Westinghouse Consolidated pfd	50	48	49

NEW INCORPORATIONS.

The Rockland Electric Company, Ramapo N. Y., has been incorporated. Harry C. Wanamaker, J. I. Traphagen Suffren and J. B. Suffren, Hillburn, N. Y., are interested therein.

The Granite Land Company, Manchester, Va., capital stock $40,000, has been formed to erect electric works, etc. W. D. Clopton, J. F. Bradley and J. W. Bronaugh are the promoters.

The Fryeburg Manufacturing Company, Fryeburg, Me., capital stock $25,000, has been formed to manufacture and deal in electricity, etc. The promoters are A. R. Jenness, E. E. Hastings and F. L. Mark.

The Long Island Traction Company, Norfolk, Va., capital stock $30.000,000, has been formed to manufacture and supply powers for railroads. J. H. Scoville, T. S. Smith, and W. H. White are the promoters.

The Worcester Construction Company, Worcester, Mass., capital stock $20,000, has been formed to construct electric railways, etc. C. A. Richardson, W. L. Kendall and M. P. McGrath are the interested parties.

The Pacific Sanders Electric Light and Manufacturing Company, San Francisco, Cal., capital stock $500,000, has been formed to manufacture and deal in carbons and lamps for electric lighting and machinery and supplies of all kinds. F. C. Stover, Robt. A. Rose, Geo. C. Holbrook, Alameda; Andrew White and W. C. Lewis, San Francisco, Cal., and John T. Sanders, Portland, Ore., are the promoters.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-176 Times Building, New York, April 17, 1893.

Mr. A. P. Eckert left for Chicago Wednesday last, where he will have charge of the exhibit of Kerite wires and cables. Visitors may feel assured of a hospitable and courteous greeting from Mr. Eckert.

Mr. A. H. Patterson, manager of the Phœnix Glass Company, while en route to Chicago, was taken ill with "la grippe." He was confined to his hotel in Pittsburgh for a week and then returned to New York. His many friends will be pleased to learn that he has fully recovered.

The Cutter Electrical Manufacturing Company, of Philadelphia, has recently appointed Mr. Chas. D Shain, of 136 Liberty street, New York, to represent it as Eastern agent. Mr. Cutter is to be congratulated upon having secured the services of one so well and favorably known to the electrical profession as Mr. Shain.

The Board of Electrical Control at its last meeting directed the Empire Subway Company to build low tension subways in 125th street, from First to Third avenues; in Sixty-fifth street, from Ninth to Eleventh avenues; and in Seventh avenue, from 110th to 138th streets, the latter to be built under the sidewalk. Permission was given to the Consolidated Telegraph and Electric Subway to build high tension subways in Pearl street, from John street to Hanover square; in Battery place, from Greenwich to West streets; in Spruce street, from Nassau to William; in Park place, from Greenwich to West streets; in Avenue B, from Seventh to Fourteenth streets; University place, from Waverley place to Fourteenth street, and in Fourth avenue, from Fortieth to Forty-second streets. A number of permits for stringing wires were granted to the Telephone Company, and an application to build a subway in Fifth avenue, from Forty-second to Fifty-ninth streets, was denied. The Secretary was directed to put the working force of the board to work at once to remove every pole that does not conform to the regulations of the board, and the Mayor gave an emphatic assurance of his active support in this measure.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., April 15, 1893.

Northfield, Mass., will probably put in an electric light plant the coming summer.

Watson J. Miller and Aaron J. Smith have applied for incorporation for the Shelton Street Railway Company.

The Brown & Sharpe Manufacturing Company, Providence, is erecting a four-story addition, 50 × 200 feet.

The Embryo Electric Light Company, of Portland, Conn., it is reported, has contracted with the quarry companies for all power purposes except traction.

The East Middlesex Street Railway Company has been granted permission to lay tracks and erect poles on Second street, Chelsea, Mass., to the Everett line.

Joseph E. Hubinger will erect a business block at New Haven, Conn., after the plans by Henry Austin's Son. The structure will be wired for incandescent electric lighting.

Melrose and Stoneham have given a franchise to the Boston, Malden & Stoneham Street Railway Company, but the Malden Board of Aldermen still have the matter under advisement.

Capt. William Brophy read a paper on the "Hazard of Electricity" before the Society of Arts on Thursday evening last. This was followed by a discussion which many gentlemen participated in.

Henry A. Richards, N. D Canterburt and E. J. Pitcher have been appointed a committee to investigate the subject of electric lighting for Weymouth, Mass., with a view to establish a municipal plant.

The Windsor Locks Electric Lighting Company, of which E. D. Bailey is president, and William Mather treasurer and general manager, will increase the capacity of its plant and extend its electric light system.

E. P. Shaw, of Newburyport and Boston, it is said will build at once the section of street railway necessary to connect the Haverhill & Groveland street railway at West Newbury with the electric road at Newburyport. The distance is about four miles.

The Tay Electric Light Company, of Perth, Can., has been organized with a capital of $30,000, for the purpose of building and operating an electric light plant at that place. Thomas A. Code, George R. McCarthy, John Wilson and Jas. M. Balderson, all of Perth, are the directors.

PITTSBURGH NOTES.

Pittsburgh, Pa., April 15, 1893.

The East End Electric Light Company, of this city, has declared a quarterly dividend of 1¼ per cent.

The electrical workers of Pittsburgh and Allegheny have organized and a membership of 2,500 is anticipated by the men in a few months. National President Henry Miller, of Detroit, Mich., was present and conducted the organization. The national order is said to number 35,000 members.

The Allegheny County Light Company has recently inaugurated the plan of furnishing arc light service during the day time in a number of the larger stores in the downtown business portion of this city, a system which has already met with great popularity among the local business men.

The Johnson Steel Rail Company, of Johnstown, Pa., has made some very interesting tests with its new welding machine. One of the tests, which was made on the street car tracks, was made yesterday and proved highly successful. The machine was placed over a joint and the current was turned on. In less than a minute the ends of the rails changed color and inside of three minutes the iron was white hot. Then the ends of the rails were brought together under high pressure and a perfect weld was made in all cases where the conditions were right. The introduction of the system is said to be of great importance to railroad builders, and the tests were watched by a large number of experts.

Prosperity.—During March, the twelfth month of the fiscal year of the company, the Westinghouse Electric and Manufacturing Company manufactured and shipped goods to the value of $857,000, making the total output for the year $5,800,000. The increase on the present capacity of the works as compared with the beginning of the year is nearly 100 per cent. by reason of the addition of new machinery and the lease of the old air brake works in Allegheny. The net earnings after providing for all ordinary and extraordinary expenses have averaged 25 per cent. of the amount of the sales, so that the earnings for the year ending March 31 will add between $1,100,000 and $1,200,000 to the surplus of the company after providing for the 7 per cent. dividends on the preferred stock. There are engaged in the Pittsburgh, Allegheny and Newark works between 3,600 and 3,700 men, for which the distribution of wages every two weeks amounts to $65,000. The company sustained no losses during the year. During last month, which was the banner month, $615,000 worth of business came to the company without solicitation. These figures answer all the criticisms which have recently been made upon the business methods of the Westinghouse company, and in particular refute the assertions so frequently made that the Westinghouse company for the sake of doing a large business was selling its apparatus at unprofitable rates.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, April 15, 1893.

Mr. F. G. Beach, general superintendent of the Central Union Telephone Company, has been promoted to be its general manager, the appointment taking effect on April 5, 1893. His office will be at Room 1306, Ashland Block, Clark and Randolph streets, Chicago.

The Nowotny Electric Company, Cincinnati, O., the well known manufacturers and dealers in electric light and street railway supplies, have been appointed exclusive agents in the State of Ohio for the Meston alternating fan motor, and the Chicago Electric Motor Company's direct current fan motors.

Taylor, Goodhue & Ames have been appointed general Western agents for the product of the "Century" factory, including Century line wire, insulating paint and insulating tape. Messrs Taylor, Goodhue & Ames will move on May 1 to the store on the ground floor at 348 Dearborn street. This company reports a brisk demand for Wagner car motors and other apparatus handled by it.

The Clayton & Lambert Manufacturing Company, of Ypsilanti, Mich., whose soldering apparatus is largely used by electricians, had an unpleasant experience with a cyclone recently which badly wrecked their factory. The roof was lifted and rearranged to suit the fancy of the playful Western zephyr on a spree, and considerable damage done otherwise, which, however, we learn will not prevent a reasonably prompt filling of orders.

The Ansonia Electric Company will have in their pavilion at the World's Fair an interesting exhibit by the Carpenter Electric Heating Manufacturing Company, of apparatus for the application of electricity to domestic uses, which will be under the special charge of Miss Helen Louise Johnson, the associate editor of *Table Talk*. The ladies will be interested in witnessing the use of a current of electricity to fry pancakes, roast turkeys, and other culinary operations, as well as to heat curling and flat irons, while skeptical people and doubters may see the possibility of using electric currents for heating rooms.

The Ball & Wood Company, of New York, is the first to have its exhibit complete in Machinery Hall at the World's Fair, under the supervision of its engineer, Mr. Wyckoff, and it is already attracting much attention. It consists of two standard simple engines of 150 h. p. each; two 150 h. p. tandem compound engines, and one 200 h. p. cross compound engine. These engines are connected with Brush dynamos. The business of the Ball & Wood company in Chicago will be conducted in its own name with Mr. W. B. Pierson and Mr. Thomas C. Perkins as associate managers, Mr. Pierson having in his special charge the business connected with the large vertical engine this company is now bringing out, while Mr. Perkins will give his attention to engines of the horizontal type.

The Ansonia Electric Company, formerly the Electrical Supply Company, has issued a new catalogue of electric and combination fixtures which is sure to attract considerable attention, as it is a departure from the usual form. It consists of substantially bound black cloth covers lettered in gold, containing a goodly number of gummed stubs, so that as the company issues from time to time a handsomely engraved sheet of its apparatus it can be inserted after the manner of a souvenir or stamp album. It is thus possible to keep the catalogue up to date without the necessity of a new edition being printed at impracticably short intervals. The whole thing is finely finished and reflects great credit upon the Ansonia Electric Company. Unquestionably the idea will prove to be a popular one, and this catalogue will be preserved where many others now find their way to the waste basket.

Cleveland, O., April 15, 1893.

Prof. E. P. Roberts recently delivered a lecture at the Case School of Applied Science on the subject of incandescent lighting, explaining the manufacture and characteristics of incandescent lamps, the method of distribution of current to the same, and the means employed to regulate the current.

The Enterprise Electrical Manufacturing Company, Cleveland, O., of which Thomas Collins is president, John Faulkner secretary and treasurer, and A. Oppenheimer manager, has opened its office at 231½ Seneca street. It will manufacture watchman's clocks, do wiring and construction work, and deal in electrical supplies.

The Reliance Gauge Company, Cleveland, O., has arranged to appear at the World's Fair with a very fine exhibit of its safety water columns and low water alarm apparatus. This will be displayed in the Electricity Building in a space 23 × 14 feet, and a practical working exhibit of three different power plants using the Campbell & Zell, Heine and Stirling boilers will be made.

The Ford-Washburn Storelectro Company, of Cleveland, O., has been granted a franchise to build and operate a street railway on Wilson avenue, Cleveland, about four miles in length. A company has been organized with $200,000 capital. The cars will be equipped with Ford-Washburn motors and run by their storage battery system. The franchise forbids the use of the trolley. This company is very busy filling orders and last week shipped 100 storage cells of large capacity to St. Louis, a number to Chicago, one 400-light dynamo to Kansas City, three 5-h. p. and two 7½-h. p. motors to Boston, besides several other orders.

Mr. C. W. Wason, at a recent meeting of the Electric Club, delivered an admirable paper on rail bonding, showing samples of various rail bonds and specimens of bonding. He then showed a sample which he considered the best, which consists in drilling a hole in the rail midway between the ends, tapping the hole with a taper tap, and screwing into the same a galvanized bolt passing through a washer fastened to the bond wire riveting the end of the bolt, and then soldering all together, using resin as a flux. The bolt head and all exposed portions are then shellacked, and covered with asphaltum. The bond wire is then fastened to a wire running close to the rail, and at every 500 feet a lateral wire is run, bonding together all the return wires, and running in a trough under the street to a pole and running up it to a return wire. Mr. Wason claimed that by this means good contact was made, bond wires were not broken as occurs when fastened near the end of the rails, by using two track wires one was practically sure to be in good condition, and that by not relying upon the ground for return all losses incident to bad return circuits were avoided, and that additional return feeders could be run whenever additional supply feeders were needed. The discussion was participated in by Mr. Foote, Mr Hoag, Mr. Fuller, Mr. Barbet, Mr. Roberts, and others.

ENGLISH NOTES.

(*From Our Own Correspondent.*)

London, March 29, 1893.

London Telephones.—It is announced that the National Telephone Company proposes to reduce the annual rental for private house telephones to £10 per annum, the price of business telephones remaining as at present, at £20 per annum. The reduced rental will only be given on a five years' contract, a similar contract in the case of business telephones resulting in a discount of £3 per annum. It is also stated that the twin wire system will be shortly pushed forward. *Qui vivra, verra?*

Free Wiring.—No electricity supply company in this country has as yet undertaken to advocate and practice free wiring, as has been the case to some extent in Canada. Owing, however, to the fact that a large majority of the residences in our towns are taken on three-year agreements or seven-year leases, the spread of electric lighting is largely retarded, and a time will no doubt come when electricity supply companies in search of a dividend will have to face the question and see whether at any rate the wiring of consumers' premises on favorable terms will not be advisable. A step in this direction has been taken by one of our youngest electric lighting companies, viz., that at Cambridge, which has deemed it expedient to undertake itself the wiring of houses and the supply of fittings at the lowest possible price consistent with good workmanship.

London Electric Railways.—The proposal to run a tubular electric railway from the great railway junction at Clapham under the river to Kensington and Paddington, the terminus of the Great Western Railway, which was defeated last year, has met with a similar fate this year, after a fight before a select committee of the House of Commons; and notwithstanding the willingness of the promoters to employ a complete metallic circuit throughout and to place themselves entirely in the hands of the Board of Trade in the matter of precautions which should be taken to avoid mechanical, magnetic and electrical disturbances to the Royal College of Science and the Central Institution in Exhibition Road. From an electrical engineering point of view, it is a pity that this line has not been allowed to go forward, since two novelties were proposed, viz.: the employment of a pressure of 1,000 volts, and complete metallic circuits. On the other hand, the promoters appear to have made a great tactical error in refusing to deviate their line of route so as to satisfy the professors, who, though naturally alarmed about their laboratories and the delicate instruments contained therein, only insisted upon the line passing nowhere closer than 400 yards to this scientific centre of London. A member of the committee seemed to think that the great advantage of the employment of an insulated return was that the electricity in this way was brought back to the dynamo, and could be used over again, somewhat in the fashion of the oil circulating arrangements so common on your side of the Alantic. No doubt it required a great deal of self-restraint on the part of the witness (Prof Ewing) to whom this suggestion was made, not to reply that, on the contrary, it would be better to allow the electricity to go back *via* the earth, in order that it might be thoroughly filtered.

News of the Week.

THE ELECTRIC LIGHT.

Jersey City, N. J.—Sealed proposals will be received until April 27 for the erection and equipment of a complete electric lighting plant.

Notre Dame, Ind.—St. Mary's Academy contemplates the purchase of an electric light plant for the illumination of the entire institution.

Barrington, R. I., has voted to replace the present oil lamps with electric lights, the current to be furnished by a plant at Warren, R. I.

Fort Tobacco, Md.—C. D. Lancaster, of Washington, D. C., has purchased the summer resort at Chapel Point, and will put in an electric lighting plant.

The Akron (O.) General Electric Light Company has secured an additional five years' contract for lighting the city, at three cents per arc light per hour.

Louisburg, Pa., has notified C. S. Pardoe and C. W. Messemer that they have failed to live up to their contract and must remove their wires and poles at once. It is understood that they will comply, and that the city will establish a plant at a cost of $15,000.

At a recent meeting of the Philadelphia Board of Legislation an ordinance was offered to contract with the Edison Electric Light Company at $84.40 an arc for lighting Eden Park and parts of Court and Windsor streets, now being lighted by the Brush company at $144 per arc.

The Barberton (O.) Electric Light Company, of which B. F. Kroon is president, and F. H. Bostwick is secretary and

treasurer, will start its new plant on May 1. It has contracted to furnish arc lights at three cents per lamp per hour, and incandescent lights at 20 cents per kilowatt hour The plant equipment consists of one 50-light arc, one 500 and one 1,000-light alternating machine, all of the General Electric Company's make, Stirling boilers, Buckeye engines, and the Falls Rivet and Machine Company's clutches.

The Roanoke Electric Light and Power Company, of Roanoke, Va., was given on Jan. 26, 1893, by the city, a contract for 100 arc lights at a price of 24 cents per night, on a schedule of "all night and every night." According to the terms of the contract 50 were to be turned on 60 days after acceptance of contract by the electric light company and 50 more within 120 days. The contract was accepted Feb. 3. The light committee did not locate until Feb. 28, which delayed the ordering of wire and poles and the supplies. Work was begun March 2, and by April 1 537 poles had been erected, 11 miles of circuit wire and 50 lamps put in position. After a few evenings test the lights were officially turned on, rental beginning April 4. It is expected the remaining 50 lights will soon be in position, with a total of 24 miles of wire. The system is Thomson-Houston lamps, standard 2,000 c. p., and they are giving excellent satisfaction. The electric light company has at present a plant of 5,500 incandescent lights, 200 arcs city and commercial. Improvements are contemplated in way of new power station and additional machinery. The company is officered as follows: Jos. T. Engleby, president; S. W. Jamison, vice-president and treasurer; Geo. C. McCahan, secretary and W. Frank Carr, general manager and superintendent.

THE ELECTRIC RAILWAY.

Congressman Tom L. Johnson is credited as being the promoter of a syndicate to build an electric railway between Pittsburgh and Cleveland. The length will be a little over one hundred miles and only one stop will be made between the two cities. A combination, it is said, will be made with the Beaver Valley and Youngstown electric lines.

The Versailles Electric Railway, of McKeesport, was granted a charter on condition that its road should be finished and in operation within 90 days of the granting of the charter, but these conditions have not been fulfilled, and citizens are urging that steps be taken in reference to the matter. It is stated that the company expects the McKeesport & Reynoldton to buy its line and finish it.

The Canadian General Electric Company has secured a franchise for an electric street railway to operate on the trolley system at Peterboro, Ont., for a term of 20 years. The first section down the main street of the city is to be in operation by Aug. 1 and the work is to be begun immediately. This system is to be only operated by the company and a water power plant will probably be installed

An electric street railroad is being constructed in Thomasville, Ga., to connect the Savannah, Florida & Western Railroad and the new cigar factories in "La Cubana City." The road will be of standard railway gauge to admit of freight cars being transferred to and from the factories, and is to be equipped with two 16-foot closed body cars, each car to be furnished with two motors, 15 h. p. each, of the General Electric S. R. G. type.

The People's Traction Company and the People's Passenger Railway Company, of Philadelphia, have executed a contract whereby the former corporation will equip the People's Line with the trolley system. Messrs. J. L. Jones and E. J. Moore have retired from the board of directors of the People's Passenger Railway Company, and are succeeded by C. F. Fox and E. J. Matthews, who were also directors of the People's Traction Company.

The Nassau Electric Railway Company was granted a franchise by the Brooklyn (N. Y.) Board of Aldermen for no consideration, although the Brooklyn City Railroad stood ready to offer $150,000 in cash for the same franchise. The Brooklyn City Railroad was granted a franchise covering a number of streets not included in the application of the Nassau company. The action of the Board of Aldermen has caused much comment, and an investigation is being made to ascertain why such a grant was made in the face of the present financial condition of the city.

The Baltimore & Washington Electric Railway.—It is reported that all franchises and rights of way have been secured or guaranteed for an electric railway between Baltimore and Washington. About a year ago a charter was obtained for a road from Baltimore to Ellicott City, and later in the year a road was projected from Washington to Ashton in Montgomery county. The promoters of the two schemes have combined forces and with a capital of $1,500,000, all of which is said to be subscribed by Baltimore, New York and Boston capitalists, will immediately begin work on the two roads which will connect Baltimore with the national capital. The route as laid out will be about 38 miles long, and will pass through all the principal towns of Howard, Baltimore and Montgomery counties within reach. It is stated that this road has no connection with the road projected by the Baltimore Traction Company.

PERSONAL NOTES.

Mr. A. de Lew, of the firm of De Lew & Bailey, electrical and mechanical engineers, 213 East Lombard street, Baltimore, Md., has received the degree of LL. D. from the Baltimore University of Medicine and Law. Mr. De Lew will commence practice at the bar, but will continue his connection with the firm.

Mr. E. G. Waters, resident manager of the General Electric Company, at Pittsburgh, Pa., was married on April 12 to Miss Byers, of Terre Haute, Ind., and after the ceremony the couple started on a wedding tour to Chicago and other cities, which will be extended until May 1, when they will return to make their home in Pittsburgh.

MISCELLANEOUS NOTES.

Electrical Legislation in Pennsylvania.—The Pennsylvania Legislature has recently devoted a great part of its attention to electrical matters, and a number of important measures in relation thereto are being considered. A bill applying to Philadelphia and alleged to be in favor of a traction syndicate opposed to the substitution of electricity for motive power has been killed by the substitution of one prepared by friends of rapid transit by electricity. A bill applying to the entire State and in favor of electrical rapid transit has been introduced as well as another of the same character applying to rural electric roads. Another measure in process of consideration regulates the price of electric lighting, and a committee has been appointed to investigate the alleged Philadelphia Electric Light Trust. The charges and countercharges growing out of these various measures have brought several of them into considerable prominence.

Those Harmless Cable Cars.—The other day in Chicago one of those harmless cable trains which, as we are told by the daily press, are absolutely safe as compared with the deadly trolley cars, got tangled up in the cable and was whirled ten blocks to meet its destruction in a tunnel at the foot of a grade. To use the words of a Chicago daily, "Only four persons seriously injured; most extraordinary under the circumstances." Before the days of the trolley occasionally a pair of mules mustered up spirit enough to run away, but it was thought that even that source of danger no longer existed. Apropos of this interesting incident, it may be noted that the Police Commissioners of New York City have adopted a recommendation of Superintendent Byrnes to establish special posts at five street crossings to prevent persons from being run over by vehicles Two of these crossings are on the cable line in 125th street, which suggests that when cables are in use in Broadway and Third avenue the dangers of travel in our streets may be measurably increased. And yet the mere suggestion of a trolley car on the streets of New York raises a whirlwind of protest!

Historical Exhibits at the World's Fair.—A communication has been received from the American Institute of Electrical Engineers, signed by Messrs. W. J. Hammer, F. R. Upton and W. A. Kreidler, constituting the Committee of Ways and Means, in reference to a historical exhibit at the official headquarters of the Institute at the World's Fair. The Institute has secured rooms adjoining the offices of the Electrical Department in the Electricity Building, which are now being furnished, and the secretary of the Institute, Mr. Ralph W. Pope, will be in general charge during the exhibition. The committee, on behalf of the council, extend an invitation, not only to members but to foreigners as well, to make use of these rooms as headquarters. It has been decided to there place on exibition various objects of great scientific and historical interest, such as photographs, pictures, autograph letters, models, instruments, etc., which will be properly classified and arranged. It is therefore requested that all parties having objects which will prove of interest will communicate with the secretary, Mr. Pope, at the headquarters of the Institute, No. 12 West Thirty-first street, New York City, or with the chairman of the committee, Mr. W. J. Hammer, 527 Temple Court, New York City. As the space is somewhat limited it will be necessary to select only objects which are not too bulky and of great interest and value.

Industrial and Trade Notes.

The Electric Supply Company, 105 South Warren street, Syracuse, N. Y., reports large and increasing orders for battery cut-outs, instruments, etc., mannfactured by them.

The Caldwell Boiler Company, 15 Cortlandt street, New York City, has been awarded an order for 455 h. p. boilers by the Western Union Telegraph Company for its building corner of Broadway and Dey streets.

The American Telephone Booth Company, 18 Cortlandt street, New York City, has issued a very attractive little circular describing its sound-proof folding booths now well known wherever the telephone is in general use.

The Edison Illuminating Company, of Philadelphia, Pa., has given a contract to the Babcock & Wilcox Company for 1,700 h. p. of boilers built wholly of wrought steel, to carry 225 pounds pressure, for the new addition to station.

Cooper, Roberts & Co. have issued a very handsome catalogue which tells all about the well known Cooper engine recently described in THE ELECTRICAL WORLD. It is tastefully gotten up and contains very complete information.

The Steele Motor Company, of Cleveland, O., reports business very active and has a large number of orders on hand. Mr. R. T. Lane is now assistant manager and in full charge of the works, being successor to F. J. Lewis, resigned.

Mr. C. S. Merrill, 38 Cortlandt street, New York, agent for the Underwood Manufacturing Company, of Tolland, Conn., reports large recent sales of leather belting. Mr. Merrill's territory includes the States of New York and New Jersey.

The Huyett & Smith Manufacturing Company, of Detroit, Mich., has just shipped two 86-inch large steel plate ventilating fans to be used in the theatre of the First Regiment Building in Chicago, and to be operated by an Edison motor.

J. L. Hays & Company, Pittsburgh, Pa., have taken a contract for making 14 fine, large, marble-base switchboards for the new Horne Building, of that city. They also shipped a few days ago tablet boards to New York, Chicago, Buffalo and elsewhere.

The Burgess Soldering Furnace Company will soon place on the market a soldering furnace to burn artificial and natural gas, equipped with two cylindrical slotted burners, and warranted not to clog up with dross from soldering furnaces.

The Lundell Fan Motor in the 1893 model, manufactured by the Interior Conduit and Insulation Company, embodies a self-oiling and self-lining bearing, a new design of fan guard and a very handsome japan finish, all of which qualities have served to render it very popular.

The Wirt Indicator, manufactured by the Ansonia Electric Company (formerly the Electrical Supply Company, of Chicago), has been meeting with great favor, especially in large central stations; and the Wirt dynamo brush, made by the same company, is also winning much approval.

The Edison Manufacturing Company, 110 East Twenty-third street, New York City, has issued a little folder describing the Kennelly standard ammeter and milliammeter, from which it is apparent that these instruments have many excellent points. This company also manufactures the Edison battery fan motor.

The General Electric Company has just installed in the Society for Savings Building, Cleveland, O., two 500-light and one 1,000-light direct coupled Edison machine, one 300-light Thomson-Houston generator; and in the Cuyahoga Building, Cleveland, two 500-light direct coupled Edison generators and one 300-light Thomson dynamo.

The Case Automatic High Speed Engine is very fully described in a recent catalogue issued by its manufacturers, the J. T. Case Manufacturing Company, New Britain, Conn. This catalogue is gotten up in a particularly attractive form, and the excellent illustrations give a very correct idea of the construction and operation of these well known engines.

The Goodyear Hard Rubber Company and the India Rubber Company are the sole agents for the Chicago Wire Company, of Wilmington, Del. The first named company furnishes the insulating compound to the Chicago Wire Company, and in assuming the sole agency it is confident that it is handling a product of the very highest grade and one which will undoubtedly meet with a wide demand.

The Elliott Electric Company, of Cleveland, O., builders and repairers of all kinds of electric light and power apparatus, are so crowded with orders that their shops are running night and day in spite of the fact that they have recently installed improved machinery. The new Elliott motor continues to be in demand. The company has secured space at the World's Fair, and will make an exhibit if the necessary time is found.

The Hub friction clutch pulleys and couplings made by James Smith Woolen Machinery Company, of Philadelphia, Pa., are meeting with largely increased sales in all lines and especially in electrical work. The improved double lever clutch is run at as high speeds as 1,000 revolutions. An order for three clutches running at 900 revolutions has just been filled, and they work to the entire satisfaction of the mechanics in charge.

The Straight Line Indicator, of which Messrs. Hine & Robertson, 57 Cortlandt street, New York City, are the manufacturers, does excellent work, as a card recently taken from a Westinghouse engine running at 350 revolutions at the plant of the electric light company at Ellsworth, Kan., shows. Messrs. Hine & Robertson say that the $200 go'd offer for which a guess certificate is placed in every box of Eureka packing is attracting great attention.

The Consolidated Car Heating Company has 270 electric heaters in use on the Union Railway in New York City, and 96 of the same heaters have been in use by the Albany Railway. This represents the complete equipment of 61 cars, all of which have the regulating heater switch of the Consolidated Car Heating Company. The Consolidated Car Heating Company electric heaters are also in use to a considerable extent on several other important electric roads.

The Fontaine Crossing Company, of Detroit, Mich., has changed it name to the Fontaine Crossing and Electric Company. It has recently shipped one 150-light Fuller dynamo to be installed on the steamboat Progress, and also a plant for the steamer City of Milwaukee, to include one 300-light Fuller dynamo and two ventilating fans for the cabin, run by a Fuller motor; also, for the steamer Santa Maria one 300-light dynamo and a 6,000-c. p. search light.

The F. Holman Electric Company, of 128 Pearl street, New York City, have recently completed the installation of 70 incandescent lamps and fixtures in the Crawford Shoe Company's Brooklyn store. The flexible portable shades manufactured by this company are in great demand, and the aluminium shades are constantly growing in favor. This company will exhibit at the World's Fair a full line of its specialties, which will be included in the exhibit of Messrs. E. S. Greeley & Co.

The George W. Pierce Company, of Philadelphia, have just issued a catalogue 9 by 11 inches in size in which is illustrated the line of bronze metal pushes, bell-pulls and mouth-pieces manufactured by this enterprising firm. An additional catalogue devoted to other electrical house goods will soon be issued, as well as one of mechanical locksmiths' and bell-hangers' supplies. Most of the illustrations in the present catalogue are full size and all are well executed, showing off the different designs to advantage.

The prismatic bulb crowning the immense column which is to form the central exhibit of the Electricity Building, and which was illustrated in THE ELECTRICAL WORLD of April 1, was the work of Messrs. F. McLewee & Son, 25 Waverely Place, New York City. The bulb is 10 feet high and the largest piece of work of its kind ever attempted, and is composed of 40,000 crystal prisms which took eight men five weeks to place in position. This will undoubtedly attract marked attention at the coming Exposition.

Sheep wool cement and sectional covering, manufactured under the well known Manville patents, is largely used in connection with electric light and power plants, not only in the West, but in the East. To supply the growing demand for the covering in the various sections, there are no fewer than three separate Manville covering companies, the original one in Milwaukee, in charge of Mr. T. F. Manville, son of the inventor; another at Norristown, Pa., of which Mr. Charles Pratt is general manager, and the third at Providence, R. I., with Mr. H. Canfield as secretary and treasurer.

The J. W. Fowler Car Company is the name of a firm recently organized for the manufacture of street railway cars of every description. John W. Fowler, who is well known as the former president of the Lewis & Fowler Manufacturing company; of Brooklyn, is the president and moving spirit of the new company. R. C. Swan, formerly of the Lewis & Fowler company, is secretary, and J. W. Cooper is treasurer. The works will be located at Elizabeth, N. J., on the water front and also on the line of the New Jersey Central R. R., and will cover about 90,000 square feet of floor space, having a capacity of four cars per day. The New York office will be on the tenth floor of the Havemeyer Building, at 26 Cortlandt street. The new company starts out with every prospect of success.

A magnesium arc light carbon is reported from the Pacific coast. Electrician Goldthwaite, of Alameda, Cal., in a recent report to the Board of Trustees of Alameda, said that he had made experiments with this magnesium carbon, which is the invention of a San Francisco chemist and electrician, and that he was satisfied that it would give 15 per cent. better results than the best other makes now on the market, while for use in connection with an alternating current dynamo or storage battery he thought the saving would be from 60 per cent. to 75 per cent. "The light," he adds, "is capable of being subdivided and may take the place of incandescent light for commercial and house to house lighting The economy of the system is explained from the fact that these carbons burn in contact and practically without an arc. The system is patented and the business managed by Alameda gentlemen, with headquarters in San Francisco."

The Foster Engineering Company, of Newark, N. J., recently issued an attractive catalogue which deserves more than passing notice. It gives evidence of careful work and contains matter of interest to all in that line of business. This company does not manufacture a valve smaller than one intended for a half-inch pipe connection and weighing less than 12 pounds, while the largest is for a 12-inch outlet and weighs half a ton. Special apparatus has been designed for testing the construction and operation of these valves, and all the products sent out are subjected to very severe tests. The president and general manager of the company is Col. J. M. Foster, who is a thorough mechanic, mathematician and skilled engineer, and whose successful record shows his fitness for his present position. Mr. J. S. Mundy, known from his connection with the hoisting engine bearing his name, is vice-president of the company and has an enviable record. The secretary and treasurer is Mr. I. N. Baker, formerly an editor and for many years confidential secretary and business manager of Col. Robert Ingersoll.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filters for sale cheap. Prices on application to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Bedell & Crehore's Alternating Currents of Electricity.—What is said of it: "The book is solid in makeup and every page is devoted to some important law, principle, or method. A clear, concise and thorough exposition of the nature of alternate current working. It is produced in a form that is most useful for the purposes of the student of alternating currents and the designer and adapter of alternate current machinery and apparatus," —*Prof. Harris J. Ryan (Cornell, Minn.).*

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED APRIL 11, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

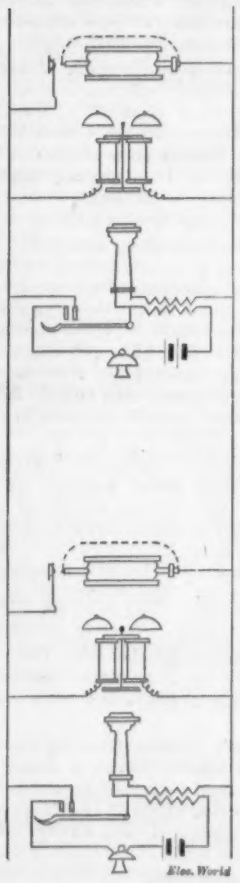
495,026. Spool for Electric Coils; George W. Demmick, Lynn, Mass., Assignor to the General Electric Company, of New York. Application filed Nov. 23, 1892. A spool for electric coils, consisting of annular metallic heads provided with notched or serrated flanges interlocked with a sheet metal body, the interlocking seams occupying shallow grooves in the heads, affording a flush surface.

495,030. Means for Telegraphing; William Henry Fahrney, Chicago, Ill. Application filed Oct. 22, 1892. The combination with a source of fluid under pressure, of a horn or whistle having a resonance tube or chamber connected therewith, and the wall or side of said tube or chamber being provided with a continuous unbroken sensitive medium, and means for vibrating said medium, whereby the capacity of said tube or chamber will be varied.

495,035. Electric-Railway Trolley; Frank Heath, Minneapolis, Minn. Application filed July 11, 1892. The combination with the base and the pole socket provided with a cam, of the cam having the cam surfaces, the chain connected to the pole cam and also to the cam surface, and suitable springs connected to the base plate and also connected by chains with the surface.

495,038. Multiple Thermal Cut-Out; Warren S. Hill, Boston, Mass., Assignor to the Thomson-Houston Electric Company, Connecticut. Application filed Aug. 10, 1889. In a multiple safety device for electrical circuits, the combination with slotted supports of a spool journaled therein having a series of fusible links arranged thereon, and removable terminals one end of each of which engaged with the spool to retain it in position and make connections with the links, and the opposite ends are connected with the lines of the circuit.

495,046. Electrical Motor; August Knoche, Elberfeld, Germany. Application filed July 22, 1892. The combination of a fixed magnet and a movable magnet, one of which is a permanent and the other an electromagnet, with a coil upon the permanent magnet, a pole changer connected to the wires of the electromagnet, and a circuit closer for opening and closing the coil of the permanent magnet.



Elec. World

No. 495,179.—System for Protecting Telephone Apparatus from Lightning.

495,047. Electrical Indicator for Rudders; Charles Y. Knowles, Somerville, N. J., Assignor to Edwin Holmes, New York, N. Y. Application filed Feb. 16, 1892. The combination with a vessel's rudder of a source of electricity, electromotive devices, yielding contact strips arranged adjacent to the rudder head or tiller, wires between said contact strips and the electromotive devices, projections carried by the rudder head or tiller adapted to close a circuit between contact strips, and a wire between certain of the strips and one pole of the source of electricity, and a wire leading from the other pole thereof to the electromotive devices.

495,058. Commutator Connector; Edward D. Priest, Lynn, Mass., Assignor to the General Electric Company, of New York. Application filed Nov. 16, 1892. A commutator segment having a slot leading from its outer surface and terminating in an enlarged recess, and means for joining an armature lead wire thereto, consisting of a connector surrounding the lead wire and passed through said slot into the recess, and there provided with means for securing it in place.

495,071. Compressed Air Apparatus; Elihu Thomson, Swampscott, Mass., Assignor to the Thomson-Houston Electric Company, Connecticut. Application filed July 11, 1891. The combination of the compressed air motive device, the air supply pipe therefor, the heating resistance arranged in heating relation to the air in said pipe, and in circuit with a source of current supply, the valve controlling the flow of air in said pipe, and the switch operatively connected to said valve and controlling the supply of electric current to the resistance.

495,077. Electric-Arc Lamp; Addison G. Waterhouse, Hartford, Conn. Application filed Nov. 28, 1892. In an electric arc lamp, a feeding mechanism consisting of main lifting clutch, actuated by the controlling magnet, and a liberating point adapted for being moved away from its contact with the main clutch, by the first movement of the carbon rod, and having means for returning it to its original position.

495,086. Voltmeter and Ampere-Meter; Eugene Gengenbach, Schenectady, N. Y. Application filed May 13, 1892. An instrument for measuring the pressure or flow of electric currents consisting of a solenoid through which the current passes, a magnetizable drum located inside of said solenoid and a loop of wire arranged to rotate around said drum.

495,087. Central Office Apparatus and Circuit for Telephone Exchanges; Edward J. Hall, Morris, N. J., Assignor to the American Telephone and Telegraph Company, New York. Application filed Oct. 13, 1892. The combination in a telephone exchange system of a series of sub-station circuits converging to a central station; with a divided switchboard, consisting, first, of a connecting switchboard provided with springjack connections, one for each circuit, and, second, a terminal or answering switchboard, at which are located springjack connections and call receiving annunciators, one for each circuit, and means for transmitting outgoing calls, the connecting switchback springjack of each circuit being located at a point thereon, external to the terminal switchboard devices, or between the same and the sub-station.

495,090. Granulated Material for Transmitting Telephones; William W. Jacques, Newton, Assignor to the American Bell Telephone Company, Boston, Mass. Application filed March 13, 1891. The herein described process of producing granulated material of high microphone power and low resistance, consisting in coating grains of carbon with powdered alumina and subjecting the coated grains to an intense white heat in an inert atmosphere.

495,107. Electrode for Secondary Batteries; George D. Coleman, Chicago, Ill., Assignor of nine-twentieths to Craig R. Guerin, of same place. The method of producing a support for a secondary battery electrode, which consists in blowing or showering the finely divided molten metal through a closed chamber or housing and receiving the same when near the point of congelation, in a suitable mold.

495,125. Electro-Magnet; Simon H. Stupakoff, Pittsburgh, Assignor to the Union Switch and Signal Company, Swissvale, Pa. Application filed September 5, 1892. The combination of an electro-magnet, an armature and a strip or sheet of magnetic material for conducting currents of residual magnetism from one pole of the magnet to the other.

495,127. Electric-Annunciator System; Edmund R. Wilder, Kansas City, Mo. Application filed June 23, 1892. In an electric signaling system, the combination of a transmitter, a receiver, an annunciator, a generator and circuit normally including the transmitter and annunciator only, a make and break switch in said circuit, a second generator and circuit including the transmitter and receiver only, and a switching apparatus adapted to cut out the annunciator and put the transmitter and receiver into circuit with both generators.

495,136. Commutator Brush; Karl Koch, Elsey, Hohenlimburg, Germany. Application filed Nov. 10, 1892. As a sliding contact piece for commutator brushes, a metallic tube, substantially as and for the purpose described. A commutator brush consisting entirely of small metallic tubes.

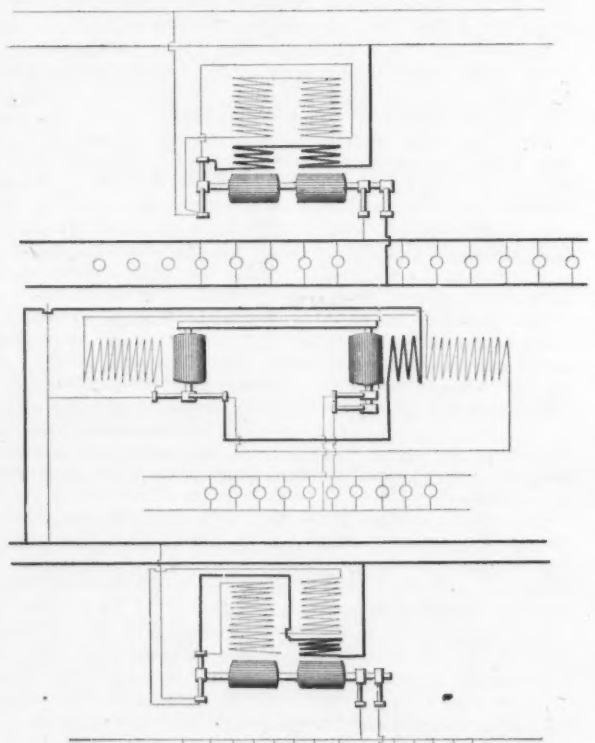
495,138. Magneto-Electric Machine; Joseph N. McLeod, Brooklyn, Assignor to the McLeod Electric Manufacturing Company, New York, N. Y. Application filed April 15, 1892. In a magneto-electric machine, the combination with the rotary armature of an operating mechanism consisting of a vertically sliding operating bar, a vibrating crank arm connected thereto, a circuit breaker connected to said arm, and a ratchet and pawl and multiplying gear mounted concentrically with said arm to be driven therefrom, said gear forming the first of a train interposed between the ratchet and pawl and the rotary armature for communicating the forward oscillations of said arm to the armature during the operative stroke of the bar.

495,139. Magneto-Electric Generator; Joseph N. McLeod, Brooklyn, Assignor to the McLeod Electric Manufacturing Company, New York, N. Y. Application filed April 27, 1892. In a magneto-electric machine, the combination with the rotary armature thereof of a multiplying train for driving the armature, an oscillatory driving shaft, an interposed ratchet and pawl, a circuit-breaker connected to said shaft, opposite stops for limiting the oscillation of said shaft, and an operating lever detachably connected to said shaft, whereby the lever may be unshipped at will without liability of misplacement of the shaft or derangement of the circuit-breaker.

495,176. Electric Battery; Frank M. Archer, New York, N. Y., Assignor by mesne assignments to the Hero Electric Company, of Jersey City, N. J. Application filed Nov. 25, 1891. In a battery the combination of a cell, a zinc element arranged close to and conforming to the inner wall of the cell, a porous cup within the zinc element and having a space between them, a porous shell or diaphragm within the porous cup, pieces of carbon between the porous cup and shell or diaphragm and carbon rods extending in o the carbon pieces and extending through the top of the cell.

495,177. Electric Battery; Frank M. Archer, New York, N. Y., Assignor by mesne assignments to the Hero Electric Company, of Jersey City, N. J. Application filed Nov. 25, 1891. In a battery, the combination of a cell, a porous shell or diaphragm arranged vertically within said cell, a zinc element within said shell or diaphragm, pieces of carbon in the space between said shell or diaphragm and the wall of the cell, and absorbent material saturated with acid and arranged in the lower part of the space between the cell and the porous shell or diaphragm.

495,179. System for Protecting Telephone Apparatus from Lightning; John Joseph Carty, New York, N. Y., Assignor to the Metropolitan Telephone and Telegraph Company, New York City. Application filed Aug. 5, 1892. A telephonic system comprising a circuit including two or more stations calling and taking apparatus at said stations, and a calling generator at each station normally forming a shunt of low inductance around said apparatus, said generator being provided with an automatic circuit-controller operative upon use of the generator to open the shunt and close the generator upon the line circuit. (See illustration.)



Elec. World

No. 495,229.—System of Electric Conversion.

495,180. Telephone Gauge; John J. Carty, New York, N. Y., and Frank A. Pickernell, Newark, N. J. Application filed Aug. 31, 1892. A gauge for testing telephones consisting of a piece of material of sufficient length to span the rim of the inclosing shell and adapted to be attracted by the magnet, the weight being such that a magnetic field of standard strength will just sustain it.

495,193. Railway Danger Signal; Arthur W. Berne, New York, N. Y., Assignor of one-half to William H. Walsh, of same place. Application filed Aug. 5, 1892. In combination, a railway track, a swinging bridge forming a support for the rails of a portion of the track, contact pieces having a normal tendency to rest in electrical contact, insulated conductors located along the track and connected, the one with one of the contact pieces and the other with the other contact piece, an insulating piece carried by the bridge and adapted to separate the contact pieces when the bridge is closed, and permit them to close when the bridge is open, and a partial electric circuit carried by a motor and including a battery and a signal, said partial circuit being in constant electrical contact with the insulated conductors.

495,225. Potential Indicator; George A. Lintner, Minneapolis, Minn. Application filed Nov. 17, 1892. The combination, with a solenoid, of a main circuit including the same, a core or armature for said solenoid, a pointer arranged to be operated by the movement of said core, contact points or blocks to be engaged separately by said pointer, translating devices included in series between said contact points, and consequently in a normally open circuit, an electric audible signal included in a connection extending from a point between said translating devices to said pointer, and a source of electrical energy included in said connection.

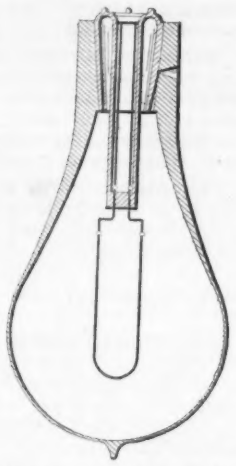
495,229. System of Electric Conversion; Edwin Wilbur Rice, Jr., Lynn, Mass., Assignor to the Thomson-Houston Electric Company, Connecticut. Application filed June 18, 1888. In a combined electric motor and generator the motor portion of which is supplied from a conductor of approximately constant potential, a regulating or controlling coil for the generator connected to a point whose potential varies with the counter electromotive force of the motor armature. (See illustration.)

495,240. Incandescent Lamp; George Hillard Benjamin, New York, N. Y., Assignor to Siemens & Halske, Berlin, Germany. Application filed Nov. 14, 1892. In an incandescent lamp, the combination of an inclosing globe, a removable base piece, a wire surrounding the base piece and having its terminals carried out of the lamp, and material surrounding the wire which, under the action of heat, will unite with the glass of which the globe and base piece are made.

495,287. Electric Alarm Clock; Thomas P. Adams, Rico, Colo. Application filed May 23, 1892. The combination with a case having on its upper side two contact plates and an intermediate insulating piece upon which and one of said contact plates an ordinary metallic lock is adapted to rest, and an electric alarm connected with the said plates, of a circuit maker adapted to be held elevated by the widening arbor of the alarm, and when released to descend upon the other contact plate and electrically connect the two plates through the medium of the clock case.

495,306. Galvanic Battery; Clyde J. Coleman, Chicago, Ill. Application filed June 6, 1891. A galvanic battery, comprising, in combination, an outer zinc cup, a porous lining of straw board in surface contact therewith, and saturated with an exciting compound, an inner electrode, and an interposed depolarizing filling.

No. 495,463.—Electric Arc Lamp Carbon.



No. 495,467.—Incandescent Lamp.

495,383. Overhead Contact Device and Switch; Charles J. Van Depoele, Chicago, Ill.; C. A. Coffin and Albert Wahl, Administrators of said Van Depoele, deceased, Assignors to the Thomson-Houston Electric Company, Boston, Mass. Application filed June 18, 1888. In electric railways the combination of a supply conductor suspended along the line of travel, a car or other vehicle having a support extending upward from the upper part thereof, and an arm hinged and pivoted to swing freely upon the support, and carrying a contact adapted to engage the suspended conductor

495,393. Apparatus for Electric Welding; Charles L. Coffin, Detroit, Mich. Application filed June 11, 1891. In a machine for electrically working metal a support, a yoke movably mounted on said support, two rotatable clamps movably mounted on said yoke, a furnace and means for maintaining an electric arc within said surface.

495,394. Machine for Electrically Welding Metals; Charles L. Coffin, Detroit, Mich. Application filed Aug. 6, 1892. In a machine for electrically heating metal, a support, a yoke movably mounted on said support, a furnace lying in the opening of said yoke, two slides mounted on ends of said yoke and movable thereon across the path of motion of said yoke, clamps mounted on said slides and a right and left threaded screw shaft connecting said slides.

495,443. Traveling Contact for Electric Railways; Charles J. Van Depoele, Chicago, Ill.; C. A. Coffin and Albert Wahl, Administrators of said Van Depoele, deceased, Assignors to the Thomson-Houston Electric Company, of Boston, Mass. Application filed March 12, 1887. The combination of a car, an overhead conductor above the car, a contact device making underneath contact with the conductor, and an arm carried by the car and carrying the contact device, and pivoted so as to swing freely around a vertical axis.

495,456. Conduit Electric Railway; William R. DeVoe, Shreveport, La., Assignor of one-fourth to C. W. Dawley, Denison, Tex. Application filed Sept. 6, 1892. In an electric railway the combination with an inclined roadbed of longitudinal base blocks in the centre of the bed, the inner meeting edges of said blocks being on a plane above the car tracks, the outer edges of said blocks being secured by a triangular strip fastened to the cross ties, and their upper surfaces declining outward and having thereon a line conductor and track supporting a trolley connected with a car.

495,461. Electric Arc Light; Rudolph M. Hunter, Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Aug. 23, 1892. In an electric lamp the combination of positive and negative carbon holders, a condensing lens arranged in the path of the projected rays of light, a semi-spherical reflector arranged in the rear of the arc and having its focal point coincident with the focal point of the condensing lens, a support for the carbon holders arranged outside of the space between the condensing lens and reflector, and means to adjust the condensing lens to and from the arc.

495,463. Electric Lamp Carbon; George Munroe Lane, Asbury Park, N. J. Application filed Sept. 11, 1890. The combination with an arc lamp, of two carbon electrodes between which the arc is formed in alignment and in direct circuit, each electrode being composed of a series of carbon pencils placed in parallel position and united by a web portion, whereby the arc travels from one pair of opposing pencils to an adjacent pair by means of the connecting web portion. (See illustration.)

495,467. Incandescent Lamp; Henry Green, Hartford, Conn., Assignor of one-half to George S. Miller, of same place. Application filed Oct. 16, 1891. In an incandescent electric lamp, the combination with the bulb or vacuum chamber, formed with a heavy neck having a funnel-shaped aperture in its side, of a stopper with a longitudinal groove traversing the lower half of the exterior thereof, opening and closing a passage between the stopper and the neck, and the disc of insulation with smaller discs of metal on its upper or outer surface, at which point the extreme outer ends of the leading-in wires terminate, and the outer portion of the stopper provided with means whereby a wrench or its equivalent may be used to overcome the resistance when rotating said stopper within the neck of said vacuum chamber. (See illustration.)

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886 can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.